7.0
RESULTS FOR INDIVIDUAL CHEMICALS

In this chapter, we present the results of our investigations of California use and emissions of individual solvent species and groups. The results of our survey of sales of solvent chemicals to California users and distributors are discussed in Section 7.1. In Section 7.2, we provide the ARB with detailed dossiers on the 20 most important industrial chemicals, plus additional dossiers for two fluorocarbons; these include information on production, end use, and availability for use in California as solvents. In Section 7.3 we present matrices of use of solvent species and classes versus Standard Industrial Classification (SIC) code, so that those interested in further research may know in which manufacturing industries these chemicals are used. Finally, market balance summaries for the 20 most important solvents are presented in Section 7.4.

7.1 PRODUCER SURVEY RESULTS

Of the 85 chemical producers surveyed, 78 responded with complete results, for a response rate of 92 percent. Table 7.1-1 presents the results of the solvent producer survey. Estimated and reported California sales and the number of responding companies for each chemical are presented. The amounts of some chemicals (e.g. MEK, kerosene, alcohols and mineral spirits) may be under-reported since some producers did not supply sales information for chemicals contained in trade-name formulations. A further source of uncertainty involves the disposition of the chemicals by distributors. The data supplied by a few of the chemical producers may not reflect the actual sales to California since many of their products move through regional distributors, who may in turn resell the products outside California. Similarly, sales by out-of-state distributors to California would not be reflected in our survey results. Producers do not keep records of where their distributors market all of their products. For this survey, we have assumed that since California is the largest industrial state in the west, most of the chemicals sold through California distributors are used in-state.

Table 7.1-1

SOLVENT PRODUCER SURVEY RESULTS

Chemical	1980 California Availability		Number of Responding Companies
	Predicted[a] (10^6 lbs)	Reported (10^6 lbs)	Total Number Expected
Acetone	80.8[b]	56.0	14/17
Amyl acetate	ND	0.6	4/4
Benzene	134.8[h,i]	62.6	30/34
Butyl acetate	8.8[b]	7.9	3/5
Butyl alcohol	33.1[b]	7.3	7/8
Chloroform	45.2	0.1	5/5
Cyclohexane	7.1[c]	0.3	9/9
Cyclohexanone	6.5[c]	7.3	8/8
Dichlorobenzene (o,p)	15.0	0.7	4/6
Diethylene glycol	60.4	15.1	5/8
Dimethyl formamide	ND	0.8	4/4
Dimethyl sulfoxide	ND	0.3	3/3
Ethyl alcohol	91.7[b]	82.9	8/9
Ethyl acetate	23.1[b]	4.3	6/7
Ethyl benzene	1.0[f]	0.9	13/14
Ethylene dichloride	143.2[b]	3.2	13/13
Ethylene glycol	143.5[b](22.5[c])	16.9	8/10
Ethylene glycol monobutyl ether	18.6[b](25.0)[c]	11.7	5/7
Ethylene glycol monoethyl ether	13.9[b](7.5)[c]	3.1	5/7
Ethylene glycol monoethyl ether acetate	ND	6.4	3/4
Fluorocarbon 11	80[b](1.0)[c]		
Fluorocarbon 113	15.1[b] (17.0)[c]		
Heptane	14.0	2.0	2/3
Hexane	ND	8.5	4/?
Hexylene glycol	10.4	1.1	2/2
Isobutyl acetate	ND	1.1	1/?
Isopropyl acetate	35.8	1.6	2/3
Isopropyl alcohol	154.1[b]	62.9	4/4
Kerosene	2,529.8	0.2	2/?

Table 7.1-1

SOLVENT PRODUCER SURVEY RESULTS
(Continued)

Chemical	1980 California Availability		Number of Responding Companies
	Predicted[a] (10^6 lbs)	Reported (10^6 lbs)	Total Number Expected
Lactol spirits	ND	0.3	1/?
Mesityl oxide	ND	0.2	2/2
Methyl alcohol	138.6[b]	137.0[d]	10/10
Methyl chloroform	72.1[b]	64.9[d]	6/6
Methyl ethyl ketone	45.4[b]	57.8[d]	6/7
Methylene chloride	57.6[b]	60.8[d]	6/6
Methyl isobutyl ketone	9.3[b]	6.2	7/8
Mineral spirits	ND	61.2	5/?
Monochlorobenzene	12.1[b]	0.0[g]	4/5
Naphtha	2,767.9	1.1[g]	1/?
Nitropropane	4.2[b]	1.3[d]	1/1
Perchloroethylene	61.9[b]	63.9[d]	7/7
Propyl acetate	6.7[b]	1.6	3/4
Propyl alcohol	11.7[b]	1.5	3/4
Propylene glycol	30.9[b]	9.9	4/5
Propylene oxide	ND	0.9[g]	2/?
Stoddard solvent	ND	1.3[g]	1/?
Toluene	57.8[b,h]	62.9[d]	24/26
Trichloroethylene	25.7[b]	11.5[d]	3/3
Triethanolamine	9.5[c]	4.1	4/?
Triethylene glycol	2.5[c]	1.4[g]	8/9
VM & P Naphtha	ND	29.8[g]	3/?
Xylene	151.7[b,h]	43.0	19/23
Other hydrocarbon solvents[e]	--	83.1	

ND = No data available on national production.

[a] Unless otherwise stated, these estimates were determined by multiplying national sales as reported in Chemical & Engineering News, 59(23), June 8, 1981, and USITC and USDOC data by 0.135 (California use factor). Estimates based on this method are subject to considerable error.

Table 7.1-1

SOLVENT PRODUCER SURVEY RESULTS
(Continued)

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[b] Estimate based on information compiled in chemical dossiers completed by SAI; method more refined than that used in footnote "a." (See Section 7.2 for details.)

[c] Estimate of total industry sales to California provided by individual chemical companies.

[d] Data provided by the Halogenated Solvents Industry Alliance.

[e] As reported by one chemical company; individual chemical species breakdown unavailable.

[f] Almost all ethyl benzene is used as an intermediate in styrene production (assume 99.9%); there is no styrene production in California. Therefore, 0.1 percent was factored into the formula used in footnote "a."

[g] Data were under-reported due to chemicals' inclusion in brand name formulations which were not regularly reported by chemical companies.

[h] Amount in gasoline pool omitted; chemical is a natural component in gasoline.

[i] Use as solvent is negligible; total includes feedstock use for cumene and alkylbenzene use minus amount in gasoline.

During the survey, a few companies initially declined to give information because of confidentiality claims and concerns over how the data would be used and interpreted. All of those companies who initially declined eventually did supply complete information in the form of either company sales to California or, if they happened to be the major supplier of a particular chemical, their best estimate of total industry sales of certain chemicals to California markets. The Halogenated Solvents Industry Alliance (HSIA), a group of halogenated solvent producing companies, provided an estimate of total California availability of major chlorinated solvents.

7.2 DOSSIERS ON INDIVIDUAL SOLVENT SPECIES

This section presents a variety of information on those chemicals which were believed, on the basis of national use trends, to account for 95 percent of California's total chemical availability for solvent use in 1980. (This total does not include chemical availability for use as feedstock or other consumptive uses.) For each chemical listed in Table 7.2-1, a detailed end use-availability profile has been compiled and appears in the following subsections. These profiles give total statewide availability, availability for solvent use and a breakdown by end use category. The purposes of compiling these profiles were (1) to establish comparison estimates for data received during the solvent producers survey; (2) to provide input data for market balances on individual solvents; and (3) to establish a methodology by which state-specific solvent use availability may be determined. Table 7.2-2 defines vapor pressure classes used in the following sections to describe the volatility of each chemical, while Table 7.2-3 gives a five class reactivity scheme for organic compounds that was used to classify each chemical's photoreactivity. In this scheme, individual reactivity ratings were assigned to each of the five classes (Trijonis et al., 1978). Compounds in Class V have the highest photochemical reactivity; those in Class I have the lowest.

Table 7.2-1

CHEMICALS FOR WHICH DETAILED DOSSIERS WERE CONSTRUCTED

Acetone	Methyl chloroform
Butyl acetate	Methylene chloride
Butyl alcohol	Methyl ethyl ketone
Ethyl acetate	Methyl isobutyl ketone
Ethyl alcohol	Perchloroethylene
Ethylene glycol	Propyl alcohol
Ethylene glycol monobutyl ether	Propylene glycol
Ethylene glycol monoethyl ether	Trichloroethylene
Isopropyl alcohol	Toluene
Methyl alcohol	Xylene

Table 7.2-2

CHEMICAL VOLATILITY CLASS DESIGNATIONS

Vapor Pressure Range (mm Hg @20°C)	Volatility Class
< 1.0 - 10	Low
11 - 60	Medium
61 - 120	High
>120	Very High

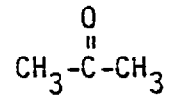
Table 7.2-3

FIVE CLASS REACTIVITY CATEGORIZATION OF ORGANIC COMPOUNDS
USED IN CHEMICAL PROFILES

Class I	Class II	Class III	Class IV	Class V
C_1-C_3 paraffins	Mono-tert-alkyl benzenes	C_{4+}-paraffins	Prim-& sec-alkyl benzenes	Aliphatic olefins
Acetylene	Cyclic ketones	Cycloparaffins	Dialkyl benzenes	α- methyl styrene
Benzene	Tert-alkyl acetates	Alkyl acetylenes	Branched alkyl ketones	Aliphatic aldehydes
Benzaldehyde	2-nitropropane	Styrene	Prim-& sec-alkyl alcohols	Tri- & tetra alkyl benzenes
Acetone		N-alkyl ketones	Cellosolve acetate	Unsaturated ketones
Tert-alkyl alcohols		prim- & -sec- alkyl acetaes	Partially halogenated olefins	Diacetone alcohol
Phenyl acetate		N-methyl pyrrolidone		Ethers
Methyl benzoate		N,N-dimethyl acetamide		Cellosolves
Ethyl amines				
Dimethyl formamide				
Methanol				
Perhalogenated hydrocarbons				
Partially halogenated paraffins				

Source: Trijonis et al. (1978)

7.2.1 Acetone



7.2.1.1 Use and Production

Acetone is a highly versatile Class I ketone of very high volatility, used mainly in the production of organic chemicals such as methyl methacrylate (25 percent), methyl isobutyl ketone (14 percent) and other (20 percent). Acetone is also used in large quantities as a solvent in paints, varnishes and lacquers (10 percent); adhesives, inks and pharmaceuticals (16 percent); and cellulose acetate spinning (4 percent). (These percentages were derived from data presented by Lee et al., 1979.) Table 7.2-4 gives a detailed breakdown of acetone use.

In 1980, 17 chemical companies produced acetone; two were located in California. California production accounted for 3.6 percent (74.7×10^6 lbs) of total U.S. production. Production of acetone increased at an annual rate of four percent from 1980 to 1981 and by three percent from 1977 to 1981 (Anon., 1982). Of the nine products for which acetone is used as a feedstock, four are actually manufactured in California: methyl isobutyl ketone, methyl isobutyl carbinol, diacetone alcohol and mesityl oxide (Anon., 1981).

7.2.1.2 1980 Availability (10^6 pounds)

U.S.: production (p) = 2,076.7
imports (i) = 149.9
exports (e) = 242.5
availability (p) + (i) - (e) = 1,984.1

California: estimated availability = 80.8 (see Table 7.2-4)
estimated availability for solvent use = 65.0

Table 7.2-4

ACETONE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Uses:				
chemical process solvent	5.2	103.2	6.4	6.6
cellulose acetate spinning solvent	4.1	81.4	11.1	9.0
pharmaceuticals	5.9	117.1	ND	
Use in Formulations:				
solvent in paints, varnishes, lacquers, thinners	10.3	204.4	12.6	25.8
solvent for acetylene in cylinders	0.5	9.9	13.4	1.3
miscellaneous (adhesives, inks, explosives, paper coatings, pharmaceuticals)	15.6	309.5	7.2	22.3
Feedstock Uses:				
bisphenol A	4.6	91.3	NA	
diacetone alcohol	2.5	49.6	-	2.3
hexylene glycol	2.6	51.6	NA	
isophorone	1.8	35.7	NA	
mesityl oxide	1.4	27.8	-	2.3
methacrylic acid & higher methacrylates	5.2	103.2	NA	

Table 7.2-4

ACETONE AVAILABILITY PROFILE
(Continued)

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
methyl isobutyl carbinol	2.3	45.6	-	5.6
methyl isobutyl ketone	13.5	267.9	-	5.6
methyl methacrylate	24.5	486.1	NA	
TOTALS	100.0	1984.1		80.8

NA = Not applicable; not manufactured in California.
ND = No data available.

[a] Derived from Lee et al., 1979.

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC 1979a; USDOC 1979b) (See Section 5.1.3 for calculation methodology.
chemical process solvent SIC code: 2800; No. of California employees = 59,459, No. of U.S. employees = 923,226; (59,459/923,226)100 = 6.4
cellulose acetate spinning solvent SIC code: 3079; (59,504/534,704)100 = 11.1
solvent in paints, varnishes, etc. SIC code: 2851; (8,050/63,988)100 = 12.6
solvent for acetylene in cylinders SIC code: 2813; (1,238/9,251)100 = 13.4
miscellaneous SIC codes: 2891, 2893, 2892, 2641, 2834; [(2,002 + 978 + 944 + 1,750 + 10,238)/(18,798 + 10,701 + 13,249 + 43,874 + 134,187)]100 = 7.2

[c] 1981 Chemical Economics Handbook, SRI; produced at Shell, Wilmington; assumed plant running at 75 percent capacity: Mesityl oxide production = 2.3 x 10^6 lbs; conversion factor (CF)=(1.22).
MIBK production = 5.6 x 10^6 lbs; CF=(1.25)
MIBC production = 5.6 x 10^6 lbs; CF=(1.25)
Diacetone alcohol production = 2.3 x 10^6 lbs; CF=(1.20)

7.2.2 n-Butyl Alcohol

$CH_3-CH_2-CH_2-CH_2OH$

7.2.2.1 Use and Production

Butyl alcohol is a Class IV substance of low volatility which is used primarily as a feedstock for butyl amines (16 percent), glycol ethers (ethylene glycol monobutyl ether) (15 percent), dibutyl phthalate (12 percent) and other (25 percent) (Anon., 1977). Butyl alcohol is also used as a solvent in formulations such as paints, lacquers, metal furniture coatings and can and coil coatings; these applications comprise the remaining 32 percent of nationwide use. Table 7.2-5 gives a detailed breakdown of butyl alcohol use.

In 1980, eight major chemical companies produced butyl alcohol, all outside California. Production of butyl alcohol increased at an annual rate of four percent between 1980 and 1981 and by six percent between 1971 and 1981 (Anon., 1982b). None of the products for which butyl alcohol is used as a feedstock is manufactured in California.

7.2.2.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 789.2
imports (i) = 5.3
exports (e) = 97.4
availability (p) + (i) - (e) = 697.1

California: estimated availability = 33.1 (see Table 7.2-5)
estimated availability for solvent use = 33.1

Table 7.2-5

n-BUTYL ALCOHOL AVAILABILITY PROFILE

End Use Cateogry	National Percent Use	U.S. Totals (10^6 lbs)	California's Percent of National Use	Calif. Totals (10^6 lbs)
Use in Formulations:				
solvent for surface coatings (in paints, lacquers, metal furniture coatings, cans and coils)	32.0[b]	223.1	14.8[c]	33.1
solvent for pharmaceuticals		ND		
Feedstock Uses[a]:				
glycol ethers (ethylene glycol monobutyl ether)	15.0	104.6	NA	
dibutyl phthalate	12.0	83.6	NA	
n-butyl acetate	9.0	62.7	NA	
butyl amines	16.0	111.5	NA	
amine resins	7.0	48.8	ND	
n-butyl acrylate	9.0	62.7	NA	
Total	100.0	697.1		33.1

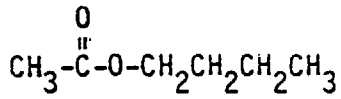
NA = Not applicable; not manufactured in California.
ND = No data available.

[a] SRI Chemical Economics Handbook, 1977.

[b] (Total percentage used as feedstock) + (x, % used in formulations) = 100; x = 32.

[c] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b) solvent for surface coatings SIC codes: 2851, 2514, 3411.

7.2.3 n-Butyl Acetate



7.2.3.1 Use and Production

Butyl acetate is a Class III compound of medium volatility. It is used as an ingredient in formulations of paints and coatings, perfumes, and flavor extractants, and directly as a solvent for leather dressing and rubber and gum manufacture (Anon., 1981). Table 7.2-6 gives a detailed breakdown of n-butyl acetate end uses.

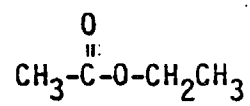
Five major companies produced butyl acetate in 1980; all were located outside California.

7.2.3.2 1980 Availability (10^6 lbs)

U.S: production (p) = 125.6
imports (i) = 0.9
exports (e) = 31.3

California: estimated availability = 8.8 (see Table 7.2-6)
estimated availability for solvent use = 8.8

7.2.4 Ethyl Acetate



7.2.4.1 Use and Production

Ethyl acetate is a Class III compound of high volatility. About 70 percent of U.S. production is used as a solvent in coatings. Applications include coatings for wood and metal furniture; trucks and buses; automotive

Table 7.2-6

n-BUTYL ACETATE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Uses: rubber mfr. leather dressing gums mfr. Use in Formulations: paints/coatings perfumes flavor extracts	100.0	95.2	9.2	8.8
Totals	100.0	95.2		8.8

[a] SRI 1981 Chemical Economics Handbook

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)
direct solvent use SIC codes: 3069, 3111, 2861
use in formulation SIC codes: 2851, 2844, 2087

primer and topcoat; and others. Ethyl acetate is also used in inks (17 percent), plastics manufacturing (10 percent) and in chemical synthesis (Lee et al., 1979). Table 7.2-7 gives a detailed breakdown of ethyl acetate end uses.

In 1980, seven major companies, all outside California, produced ethyl acetate.

7.2.4.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 224.8
exports (e) = ND (no data available)
imports (i) = ND
availability = 224.8

California: estimated availability = 23.1 (see Table 7.2-7)
estimated availability for solvent use = 22.7

7.2.5 Ethyl Alcohol

CH_3-CH_2-OH

7.2.5.1 Use and Production

Ethyl alcohol (ethanol) is a Class IV compound of medium volatility. It is used in formulations of toiletries and pharmaceuticals (21.2 percent); proprietary formulations (13.6 percent); cleaning preparations (13.1 percent) and resins and lacquers (1.1 percent). Ethanol is also used in a wide variety of industrial processes (7.4 percent), and as feedstock for the production of vinegar (8.7 percent), acetaldehyde (4.1 percent), esters (9.8 percent), amines (6.6 percent), glycol ethers (4.8 percent) and other chemicals (Anon., 1980). Table 7.2-8 gives a detailed breakdown of ethanol end uses.

None of the nine companies producing ethanol in 1980 was located in California. Production of synthetically manufactured ethanol decreased at an annual rate of 20 percent from 1980 to 1981, and by three percent between 1971 and 1981 (Anon., 1982).

Table 7.2-7

ETHYL ACETATE AVAILABILITY PROFILE

End Use Category	National Percent Use	U. S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Use:				
solvent for plastics	10	22.5	11.1	2.5
Use in Formulations:				
solvent for coatings (wood and metal furniture; automotive topcoat, primer and after-market; trucks and buses; auto refinishing; paint thinner & misc.; machinery equipment; paper, film and foil)	70	157.4	10.6	16.7
other solvent uses (primarily inks)	17	38.2	9.1	3.5
Feedstock Uses:				
chemical synthesis	3	6.7	6.4	0.4
TOTALS	100	224.8		23.1

[a] Lee et al., 1979

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)
solvent for plastics SIC code: 3079
solvent for coatings SIC codes: 2851, 2511, 2514 3713, 7535, 2641
chemical synthesis SIC code: 2800

Table 7.2-8

ETHYL ALCOHOL AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Uses:				
industrial processes	7.4	120.7	11.1[c]	13.4
Use in Formulations:				
toiletries/pharmaceuticals	21.2	345.9	8.9	30.8
cleaning preparations	13.1	213.7	10.1	21.6
lacquers and resins	1.1	17.9	9.1	1.6
proprietary formulations	13.6	221.9	9.9	22.0
Feedstock Uses:				
vinegar	8.7	141.9	ND	
acetaldehyde	4.1	66.9	NA	
acetic acid	1.5	24.5	ND	
ethyl acetate	4.0	65.3	ND	
ethyl chloride	0.6	9.8	NA	
esters	9.8	159.9	ND	
amines	6.6	107.7	NA	
glycol ethers	4.8	78.3	NA	
resins	2.7	44.0	5.3	2.3
other derivatives	0.8	13.1	ND	
Totals	100.0	1631.5		91.7

ND = No data available.
NA = Not applicable; not manufactured in California.

[a] Anon. (1980)

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)
toiletries/pharmaceuticals SIC codes: 2844, 2834
cleaning preparations SIC code: 2842
lacquers and resins SIC codes: 2851, 2821
proprietary formulations SIC codes: 2085, 2087, 2869, 2899
resins (feedstock use) SIC code: 2821

[c] NBL, 1981. National Business List figure for California's percent contribution to all U.S. manufacturing SIC codes

7.2.5.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 1,300.8
imports (i) = 396.8
exports (e) = 66.1
availability (p) + (i) - (e) = 1,631.5

California: estimated availability = 91.7 (see Table 7.2-8
estimated availability for solvent use = 89.4

7.2.6 Ethylene Glycol Monobutyl Ether

$CH_3CH_2CH_2CH_2$-O-CH_2CH_2-OH

7.2.6.1 Use and Production

Ethylene glycol monobutyl ether (butyl cellosolve) is a Class V solvent of low volatility used mainly in protective coatings (41 percent); insecticides, herbicides and inks (31 percent); and liquid household cleaners (18 percent). Butyl cellosolve is used to a lesser extent as a feedstock for butyl cellosolve acetate (9 percent) and di(2-butoxyethyl)phthalate (1 percent) manufacturing (Lee et al., 1979). Table 7.2-9 gives a detailed breakdown of butyl cellosolve end use.

None of the seven major chemical companies producing butyl cellosolve in 1980 was located in California. Butyl cellosolve was not used as a feedstock in California for the chemical products mentioned above.

7.2.6.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 220.5
imports (i) = 0
exports (e) = 44.1
availability (p) + (i) - (e) = 176.4

Table 7.2-9

ETHYLENE GLYCOL MONOBUTYL ETHER AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lb/yr)	California's Percent of National Use[b]	Calif. Totals (10^6 lb/yr)
Use in Formulations:				
protective coatings	41	72.3	13.9	10.0
diluent in hydraulic brake fluids, rust removers	ND			
solvent for metal cleaning	ND			
solvent for liquid household cleaners	18	31.7	12.7	4.0
other uses: insecticides herbicides, inks	31	54.7	8.3	4.5
Feedstock Uses:				
2-butoxyethylacetate mfg.	9	15.9	NA	
di(2-butoxyethyl)phthalate mfg.	1	1.8	ND	
TOTALS	100	176.4		18.5

ND = No data available.
NA = Not applicable; not manufactured in California.

[a] Lee et al., 1979

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns, (USDOC, 1979a; USDOC, 1979b)
protective coatings SIC codes: 2641, 2899, 341, 3479, 37
liquid household cleaner SIC code: 2842, 2841
other uses SIC codes: 2893, 2879

California: estimated availability = 18.5 (see Table 7.2-9); (25)*
estimated availability for solvent use = 18.5

7.2.7 Ethylene Glycol Monoethyl Ether

CH_3CH_2-O-CH_2CH_2-OH

7.2.7.1 Use and Production

Ethylene glycol monoethyl ether (cellosolve) is a Class V solvent of low volatility, used mainly as a feedstock for cellosolve acetate manufacture (49 percent) and as a solvent in protective coatings (33 percent). Other cellosolve solvent applications include use in adhesives, dyes, glass cleaners varnish removers and pharmaceutical extractions (9 percent); and in printing inks (9 percent) (Lee et al., 1979). Table 7.2-10 gives a detailed breakdown of cellosolve end use.

Seven major companies produced cellosolve in 1980; none was located in California. Cellosolve was not used as feedstock for cellosolve acetate production in California during 1980.

7.2.7.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 201.3
imports (i) = 39.7
exports (e) = 17.6
availability (p) + (i) = (e) = 223.4

California: estimated availability = 13.9 (see Table 7.2-10); (7.5)**
estimated availability for solvent use = 13.9

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* One chemical company's estimate of total industry sales to California = 20 to 30 million pounds.

** One chemical company's estimate of total industry sales to California = 5 to 10 million pounds.

Table 7.2-10

ETHYLENE GLYCOL MONOETHYL ETHER AVAILABILITY PROFILE

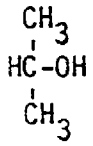
End Use Category	National Percent Use[a]	U.S. Total (10^6 lb)	California's Percent of National Use	Calif. Totals (10^6 lb)
Use in Formulations:				
printing ink	9	20.1	9.1	1.8
protective coatings	33	73.7	13.9	10.2
miscellaneous (adhesives, dyes, varnish remover, pharmaceuticial extraction, glass cleaner)	9	20.1	9.7	1.9
Feedstock Use:				
2-ethoxyethyl acetate mfr.	49	109.5	NA	--
	100	223.4		13.9

NA = Not applicable; not manufactured in California.

[a] Lee et al., 1979

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns, (USDOC, 1979a; USDOC, 1979b).
printing ink SIC codes: 2893, 271, 2732, 275
protective coatings SIC codes: 2641, 2899, 341, 3479, 37
miscellaneous SIC codes: 2891, 2851, 2834, 2842, 2816

7.2.8 Isopropyl Alcohol



7.2.8.1 Use and Production

Isopropyl alcohol (isopropanol) is a Class IV compound of medium volatility. It is used predominantly as a feedstock for acetone production (42.5 percent). The remaining applications (57.5 percent) include use in formulations of paints, toiletries, rubbing alcohol, biological products and pharmaceuticals, and as a feedstock for isopropyl acetate and amines, herbicidal esters and xanthates production (Anon., 1982a). Table 7.2-11 gives a breakdown of isopropanol end uses.

Four major companies produced isopropanol in 1980; one company was located in California and accounted for seven percent of national production. National production of isopropanol decreased at an annual rate of ten percent between 1980 and 1981; however, the rate of production has remained unchanged between 1971 and 1981 (Anon., 1982). Acetone is the only product for which isopropanol is used as a feedstock in California. Two producers are located in-state, but only one uses isopropanol as an acetone feedstock.

7.2.8.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 1,836.5
imports (i) = 44.1
exports (e) = 176.4
availability (p) + (i) - (e) = 1,704.2

California: estimated availability = 154.1 (see Table 7.2-11)
estimated availability for solvent use = 97.0

Table 7.2-11

ISPROPYL ALCOHOL AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use	Calif. Totals (10^6 lbs)
Use in Formulations:				
paints and allied products toiletries rubbing alcohol biological products pharmaceuticals	57.5	979.9	9.9[b]	97.0
Feedstock Uses:[c]				
isopropyl acetate isopropyl amines herbicidal esters xanthates acetone mfr.	42.5	724.3	-	57.1[d]
Totals	100.0	1704.2		154.1

[a] Anon. (1982a)

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)
use in formulations SIC codes: 2851, 2844, 2833, 2834, 2869

[c] No data available on isopropyl acetate, herbicidal esters and xanthates; isopropyl amine not manufactured in California.

[d] Two acetone producers are located in California; one uses isopropyl alcohol dehydrogenation and accounts for 75 percent of California's acetone production. Assuming 100 percent conversion efficiency, 1.02 pounds of isopropyl alcohol is used per pound of acetone produced. Therefore,
(0.75)(74.7 x 10^6 lbs, acetone) (1.02 lbs IPA/lb acetone) = 57.1 x 10^6 lbs IPA used.

7.2.9 Methyl Alcohol

CH_3-OH

7.2.9.1 Uses and Production

Methyl alcohol (methanol) is a Class I substance of high volatility, used predominantly as a feedstock in formaldehyde manufacture (45 percent). Methanol is also used as a feedstock for acetic acid (4 percent), DMT (9.3 percent), methyl methacrylate (8 percent), methyl amines (4 percent), methyl halides (4 percent) and others (15 percent). Methanol's solvent applications include use in chemical processing (9 percent), windshield washing preparations (1.5 percent) (derived from Lee et al., 1979). Table 7.2-12 gives a detailed breakdown of methanol end uses.

None of the ten U.S. methanol producers is located in California. Production of methanol increased at an annual rate of 18 percent between 1980 and 1981, and five percent between 1971 and 1982 (Anon. 1982). Formaldehyde is the only product for which methanol is used as a feedstock in California; its production takes place at only one location in the state.

7.2.9.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 7,153.0
imports (i) = ND (no data available)
exports (e) = ND
availability = 7,153.0

California: estimated availability = 138.6 (see Table 7.2-12)
estimated availability for solvent use = 58.1

Table 7.2-12

METHYL ALCOHOL AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Uses:				
chemical process solvent	8.8	629.5	6.4	40.3
pharmaceuticals mfr.	0.2	14.3	7.6	1.1
solvent for refining gas line and heating oil	ND	-	-[d]	
nylon-66 mfr.	0.3	21.5	8.5[d]	1.8
Use in Formulations:				
metal finish coatings	ND			
coated fabrics	ND			
dye mfr.	ND			
windshield washing preps.	1.5	107.3	13.9	14.9
Feedstock Uses:				
acetic acid mfr.	4.0	286.1	NA	
DMT mfr.	9.3	665.2	NA	
formaldehyde mfr.	45.0	3218.9	-	80.47[c]
methyl halides	4.0	286.1	NA	
methyl methacrylate	8.0	572.2	NA	
methyl amines	4.0	286.1	NA	
misc. (glycol ether mfr., formaldehyde inhibitor)	14.9	1065.8	NA	
Totals	100.0	7153.0		138.6

Table 7.2-12

METHYL ALCOHOL AVAILABILITY PROFILE
(Continuation)

NA = Not applicable; not manufactured in California.

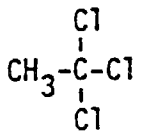
[a] Derived from Lee et al., 1979

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns, (USDOC, 1979; USDOC, 1979a)
chemical process solvent SIC code: 2800
pharmaceutical mfr. SIC code: 2834
windshield washing prep. SIC code: 2842

[c] Formaldehyde produced in Fremont, CA, by Borden, Inc. If 45 percent of all methanol produced is used for formaldehyde manufacturing, and the Fremont plant contributes 2.5 percent of the total U.S. production, then:
$(7153 \times 10^6 \text{ lbs})(0.45)(0.025) = 80.61 \times 10^6$ lbs methanol used

[d] California to U.S. SIC code ratios derived from National Business List data, (NBL, 1981), for SIC code 2824

7.2.10 Methyl Chloroform



7.2.10.1 Use and Production

Methyl chloroform is a Class I solvent of very high volatility. The predominant use of this chemical is in metal cleaning (70.6 percent). Methyl chloroform is also used in formulations of aerosols (7.5 percent), adhesives (7.4 percent), paints (1.9 percent), and inks (1.1 percent) (derived from Slimak et al., 1980b). Table 7.2-13 gives a detailed breakdown of methyl chloroform end uses.

None of the six U.S. chemical companies producing methyl chloroform is located in California. National production dropped 13 percent from 1980 to 1981 but has increased at an annual rate of five percent between 1971 and 1982 (Anon., 1982).

7.2.10.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 692.2
imports (i) = 0
exports = 55.1
availability (p) + (i) - (e) = 637.1

California: estimated availability = 72.1 (see Table 7.2-13)
estimated availability for solvent use = 72.1

7.2.11 Methylene Chloride

CH_2Cl_2

7.2.11.1 Use and Production

Methylene chloride is a Class I solvent of very high volatility. This chemical is used mainly in formulations of paint removers (30 percent);

Table 7.2-13

METHYL CHLOROFORM AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs.)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs.)
Direct Solvent Uses:				
metal cleaning	70.6	449.3	12.5	56.2
miscellaneous (unspecified solvent cleaning)	3.0	19.1	13.5[c]	2.6
textiles (scouring)	1.1	7.0	1.53	0.1
other (pharmaceutical extraction; film cleaning	0.2	1.2	6.0	0.1
Use in Formulations:				
aerosols	7.5	47.8	11.5	5.5
adhesives	7.4	47.1	10.7	5.0
paints	1.9	12.1	12.6	1.5
inks	1.1	7.0	9.1	0.6
drain cleaners	0.6	3.8	13.9	0.5

Table 7.2-13

METHYL CHLOROFORM AVAILABILITY PROFILE
(continuation)

Other Uses:			
stockpiles	6.6	42.1	ND
Totals	100.0	637.1	72.1

[a] Derived from Slimak et al., 1980.

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (except where noted) (USDOC, 1979a; USDOC, 1979b)
metal cleaning SIC codes: 254, 259, 332, 335, 336, 339, 351, 352, 353, 354, 355, 356, 357, 358, 359, 361, 362, 363, 364, 366, 367, 369, 371, 372, 376, 379, 381, 382, 39, 458, 753
other SIC codes: 2834, 386
textiles SIC code: 226
aerosols SIC codes: 2841, 2842, 2844, 2851, 2879, 2891, 2899
adhesives SIC codes: 2891
paints SIC codes: 2851
inks SIC code: 2893
drain cleaners SIC code: 2842

[c] Miscellaneous: NBL, 1981. National Business List figure for California's percent contribution to U.S. manufacturing SIC codes.

aerosols (17 percent); and herbicides, insecticides, traffic paints, adhesives, cesspool cleaners and other products (22 percent). Direct solvent uses include metal cleaning (22 percent) and pharmaceutical extractions (4 percent) (Slimak and Katz, 1981). Table 7.2-14 gives a detailed breakdown of methylene chloride end uses.

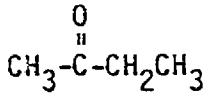
In 1980, there were six U.S. producers; none was located in California. National production of methylene chloride dropped at an annual rate of one percent from 1980 to 1981, and two percent from 1971 to 1981 (Anon., 1982).

7.2.11.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 562.2
imports (i) = 22.1
exports (e) = 66.1
availability (p) + (i) - (e) = 518.1

California: estimated availability = 57.6 (see Table 7.2-14)
estimated availability for solvent use = 57.6

7.2.12 Methyl Ethyl Ketone



7.2.12.1 Use and Production

Methyl ethyl ketone (MEK) is a Class III solvent of high volatility. MEK is used predominantly in formulations such as vinyl coatings (34 percent), nitrocellulose coatings (14 percent), acrylic coatings (12 percent) and adhesives (14 percent). Other formulations account for 19 percent. MEK is also used for extraction and production of wax from lube oil petroleum (7 percent) (Lee et al., 1979). Table 7.2-15 gives a detailed breakdown of MEK end uses.

Table 7.2-14

METHYLENE CHLORIDE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent use:				
metal cleaning	22	114.0	12.5	14.3
pharmaceutical extractions	4	20.7	7.6	1.6
Use in Formulations:				
paint removers	30	155.4	12.6	19.6
aerosols	17	88.1	11.5	10.1
miscellaneous (flask dry traffic paint; cesspool cleaners; adhesives; dye carrier; photographic coatings; herbicides, insecticides, flavorings, antibiotics, vitamin and table coatings; fire extinguishing components.)	22	114.0	8.0	9.1
Other Uses:				
foam blowing agent	5	25.9	11.1	2.9
Totals	100	518.1		57.6

[a] Slimak and Katz, 1981.

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)

metal cleaning SIC codes: (see footnote b, Table 5.4-13)
pharmaceutical extractions SIC codes: 2834
aerosols SIC codes: 2841, 2842, 2844, 2851, 2879, 2891, 2899
paint removers SIC code: 2851
foam blowing agent SIC code: 3079
miscell. paints SIC codes: 2851, 2842, 2891, 2816, 2879, 2834, 2861

Table 7.2-15

METHYL ETHYL KETONE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Use:				
lube oil dewaxing	7	37.2	10.2	3.8
pharmaceutical extractions	ND	-		
Use in Formulations:				
acrylic coatings	12	63.8	6.9	4.4
nitrocellulose coatings	14	74.4	6.9	5.1
vinyl coatings	34	180.6	6.9	12.5
adhesives	14	74.4	10.7	8.0
inks	6	31.9	9.1	2.9
miscellaneous coatings (cans, coil, paper, etc.)	7	37.2	13.9	5.2
miscellaneous uses	6	31.9	11.1[c]	3.5
Feedstock Uses:				
TPA manufacturing	ND	-		
Totals	100	531.3		45.4

ND = No data available.

[a] Lee et al., 1979.

b California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns, (USDOC, 1979a; USDOC, 1979b).
- lube oil dewaxing SIC code: 2992
- nitrocellulose coatings SIC codes: 2851, 2869, 2899
- acrylic coatings SIC codes: 2851, 2869, 2899
- vinyl coatings SIC codes: 2851, 2869, 2899
- adhesives SIC code: 2891
- inks SIC code: 2893
- miscellaneous coatings SIC codes: 2641, 2899, 341, 3479, 37

[c] NBL, 1981. National Business Lists figure for total California contribution to all U.S. marketing categories.

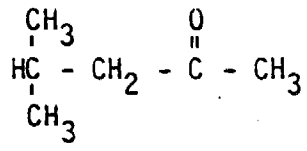
In 1980, seven chemical companies produced MEK; none was located in California. Nationwide production increased at an annual rate of seven percent from 1980 to 1981, and three percent from 1971 to 1981 (Anon., 1982).

7.2.12.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 586.4
imports (i) = 11.0
exports (e) = 66.1
availability (p) + (i) - (e) = 531.3

California: estimated availability = 45.4 (see Table 7.2-15)
estimated availability for solvent use = 45.4

7.2.13 Methyl Isobutyl Ketone



7.2.13.1 Use and Production

Methyl isobutyl ketone (MIBK) is a Class IV substance of low volatility. MIBK is used mainly in formulations such as nitrocellulose coatings (35 percent); vinyl and other coatings, and inks (25 percent); and adhesives (4 percent). MIBK is also used as an extractive solvent (10 percent) in electroplating solutions (3 percent), in magnetic tape production (5 percent), and as a chemical intermediate in the production of methyl isobutyl carbinol (10 percent) (Lowenheim and Moran, 1975). Table 7.2-16 gives a detailed outline of MIBK end uses.

In 1980, eight major chemical companies produced MIBK; one company was located in California and accounted for 6.6 percent of nationwide production.

Table 7.2-16

METHYL ISOBUTYL KETONE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Use:				
extractive solvent	10	13.4	7.8	1.0
metallurgical (electroplating solution)	3	4.0	3.4	0.1
magnetic tape production	5	6.7	12.4	0.8
Use in Formulations:				
nitrocellulose coatings	35	47.1	6.9	3.2
vinyl and other coatings; and inks	25	33.6	7.0	2.4
adhesives	4	5.4	11.0[c]	0.6
miscellaneous	8	10.8	11.1[c]	1.2
Feedstock Uses:				
chemical intermediate (primarily methyl isobutyl carbinol)	10	13.5		NA
Totals	100	134.5		9.3

NA = Not available.

[a] Lowenheim and Moran, 1975.

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)
- extractive solvent SIC codes: 2992, 2834
- metallurgical SIC codes: 331
- magnetic tape production SIC code: 3699
- nitrocellulose coatings SIC codes: 2851, 2869, 2899
- vinyl and other coatings; and inks SIC codes: 2851, 2869, 2899, 2893
- adhesives SIC code: 2891

[c] NBL, 1981. National Business Lists figure for California's contribution to all U.S. marketing categories.

7.2.13.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 167.6
imports (i) = 0
exports (e) = 33.1
availability (p) + (i) - (e) = 134.5

California: estimated availability = 9.3 (see Table 7.2-16)
estimated availability for solvent use = 9.3

7.2.14 Ethylene Glycol

CH_2-OH
|
CH_2-OH

7.2.14.1 Use and Production

Ethylene glycol is a Class I compound of low volatility. It is used mainly as a radiator antifreeze-coolant in the automotive industry (42.3 percent) and as a raw material for polyester fiber, film and bottle manufacturing (40.1, 3.7, 2.8 percent, respectively). Other applications of ethylene glycol include use in paints, coatings for metal cans and furniture, appliances, architectural coatings and inks (11.1 percent) (Lowell, 1980). Table 7.2-17 gives a detailed breakdown of ethylene glycol end uses.

Of the ten U.S. chemical companies which produced ethylene glycol in 1980, none was located in California. Ethylene glycol production increased at an average annual rate of three percent between 1971 and 1981 but decreased by eight percent between 1980 and 1981 (Anon., 1982). The chemical was not used in polyester applications in California in 1980.

Table 7.2-17

ETHYLENE GLYCOL AVAILABILITY PROFILE

End Use Category	National Percent Use	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Use in Formulations:				
antifreeze	42.3	1,760.7	4.6	81.0
others paints & coatings, metal can coating, metal furniture, appliances, machinery and equipment, metal coating, architectural coatings, inks	11.1	462.0	13.4	62.1
Feedstock Uses:				
polyester fibers	40.1	1,669.1	NA	
polyester film	3.7	154.0	NA	
polyester bottles	2.8	116.5	NA	
Totals	100.0	4,162.3		143.1 (22.5)[c]

NA = Not applicable; not manufactured in California.

[a] Lowell, 1980

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)
antifreeze SIC codes: 2869, 2899
others SIC codes: 2851, 3411, 3479, 2893

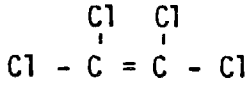
[c] One chemical company's estimate of total sales to California.

7.2.14.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 4,387.2
imports (i) = 17.6
exports (e) = 242.5
availability (p) + (i) - (e) = 4,162.3

California: estimated availability = 143.1 (62.1 - excluding antifreeze use; (see Table 7.2-17); (22.5)*
estimated availability for solvent use = 143.1 (62.1 - excluding antifreeze)

7.2.15 Perchloroethylene



7.2.15.1 Use and Production

Perchloroethylene (perc) is a Class I chemical of medium volatility. Perc is used predominantly as a solvent in dry cleaning (63.4 percent and metal cleaning (17.9 percent); other applications include use in formulations such as aerosols, paint removers, inks, antihelminthics and others (0.7 percent). Perc is also used as a feedstock in fluorocarbon 113, 114 and 115 manufacture (14.4 percent). Perc is used as a solvent for fats, greases, waxes and as a caffeine extractant in coffee; however, no quantitative data are available as of this writing for these uses (Hall and Farmer, 1980; Verschueren, 1977). Table 7.2-18 gives a detailed breakdown of perc end uses.

In 1980, no producers of fluorocarbon 113, 114, and 115 were located in California. Of the seven chemical U.S. companies which produce perc, one is located in California and accounted for three percent of national production in 1980. Perc production dropped nine percent from 1980 to 1981 but between 1971 and 1981, no change in output was registered (Anon., 1982).

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* One chemical company's estimate of total sales to California = 20 to 25 million pounds.

Table 7.2-18

PERCHLOROETHYLENE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California Percent of National Use	Calif. Totals (10^6 lbs)
Direct Solvent Use:				
dry cleaning	63.4	457.1	9.6	43.9
metal cleaning	17.9	129.0	12.5	16.1
solvent for fats, greases waxes, caffeine from coffee	ND			
Use in Formulations:				
miscellaneous (aerosol products for laundry treatments; veterinary antihelminthics; solvent for silicones; paint removers; inks)	0.7	5.0	8.0	0.4
Feedstock Uses:				
fluorocarbon 113, 114, 115 mfr.	14.4	103.8	NA	
Other Uses:				
grain fumigant	3.6	26.0	5.8 (~~2.7~~ error)	1.5
Totals	100.0	720.9		61.9

ND = No data available.
NA = Not applicable; not manufactured in California.

[a] Derived from Hall and Farmer, 1980; Verschueren, 1977

[b] California to U.S. SIC code ratios by number of employees from 1979 California Business Patterns, (USDOC, 1979a; USDOC, 1979b)
dry cleaning SIC codes: 2715, 2716, 7218
metal cleaning SIC codes: (see Table 5.4-14)
grain fumigant SIC codes: 2048
miscellaneous SIC codes: 2841, 2842, 2844, 2899, 2869, 2851, 2893

7.2.15.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 765.0
imports (i) = 33.1
exports (e) = 77.2
availability (p) + (i) - (e) = 720.9

California: estimated availability = 61.1 (see Table 7.2-18)
estimated availability for solvent use = 60.4

7.2.16 Propyl Alcohol

CH_3-CH_2-CH_2-OH

7.2.16.1 Use and Production

Propyl alcohol (propanol) is a Class IV compound of medium volatility. Propanol is used predominantly as a feedstock for propyl amines (45.3 percent) and propyl acetate (22.6 percent). It is also used in acrylonitrile spinning; formulations of inks and surface coatings (27.9 percent); and as a feed additive (4.2 percent) (Anon., 1982a). Miscellaneous propanol applications include use in floor wax, brake fluid, cleaning preparations and as a solvent for resins, cellulose esters, waxes and vegetable oils (Verschueren, 1977). Table 7.2-19 gives a breakdown of propanol end uses.

Four major companies manufactured propanol in 1980; all were located outside California.

7.2.16.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 392.4
imports (i) = 0
exports (e) = 33.0
availability (p) + (i) - (e) = 359.4

Table 7.2-19

PROPYL ALCOHOL AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (11^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Uses:				
solvent for resins, cellulose esters, waxes and vegetable oils	ND			
acrylonitrile spinning				
Use in Formulations:	27.9	100.3	10.8	10.8
inks surface caotings miscellaneous (floor wax, cleaning preps, brake fluid mfr., antiseptic mfr.)	ND			
Feedstock Uses:				
propyl amines	45.3	162.8	NA	
propyl acetate	22.6	81.2	ND	
Other Uses:				
feed additive	4.2	15.1	5.7	0.9
Totals	100.0	359.4		11.7

ND = No data available.
NA = Not applicable; not manufactured in California.

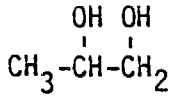
[a] Anon. (1982a); Verschueren, 1977

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)
acrylonitrile SIC code: not manufactured in California
[illegible]ks, surface coatings SIC codes: 2893, 2851

[c] Feed additive SIC code: 2048.

California: estimated availability = 11.7 (see Table 7.2-19)
estimated availability for solvent use = 10.8

7.2.17 Propylene Glycol



7.2.17.1 Use and Production

Propylene glycol (PG) is a Class IV compound of low volatility. PG is used predominantly as a feedstock for unsaturated polyester resins (46 percent). In formulations, PG is used in pharmaceuticals (10 percent), pet food (8 percent), paints (7 percent) and functional fluids (8 percent). Other applications include uses as a tobacco humectant (7 percent), plasticizer feedstock and cellophane softening agents (6 percent) (Anon., 1982). Table 7.2-20 gives a breakdown of PG end uses.

None of the five U.S. producers of PG in 1980 was located in California. Production of PG decreased at an annual rate of seven percent from 1979 to 1980.

7.2.17.2 1980 Availability (10^6 lbs)

U.S.: production = 487.1
imports = (no data)
exports = (no data)
availability = 487.1

California: estimated availability = 30.9 (see Table 7.2-20); (18.0)*
estimated availability for solvent use = 14.7

---

* One chemical company's estimate of total industry sales to California = 16 to 20 million pounds

Table 7.2-20

PROPYLENE GLYCOL AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Uses:				
tobacco humectant	7	34.1	0.3	0.1
Use in Formulations:				
pharmaceuticals	10	48.7	7.6	3.7
pet food	8	39.0	7.6	3.0
functional fluids	8	39.0	9.3	3.6
paints	7	34.1	12.6	4.3
Feedstock Uses:				
unsaturated polyester resins	46	224.1	5.3	11.9
plasticizers	6	29.2	11.1	3.2
Other Uses:				
cellophane softening agent	6	29.2	NA	
miscellaneous	2	9.7	11.1[c]	11.1
Totals	100	487.1		30.9

NA = Not applicable; not manufactured in California.

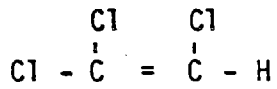
[a] Anon. (1980)

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)

tobacco humectant SIC code: 213
pharmaceuticals SIC code: 2834
pet food SIC code: 2047
functional fluids SIC code: 2899
paints SIC code: 2851
unsaturated polyester resins SIC code: 2821
plasticizers SIC code: 3079

[c] NBL, 1981. National Business Lists figure for California's contribution to all U.S. marketing categories.

7.2.18 Trichloroethylene



7.2.18.1 Use and Production

Trichloroethylene (TCE) is a Class I solvent of medium volatility. The demand for TCE has decreased sharply over the past several years. The decline is the result of regulations imposed by the Los Angeles Rule 66 and similar regulations related to ozone depletion, OSHA and FDA regulations, and results of studies suggesting that TCE is a carcinogen. TCE has been used predominantly as a metal cleaning solvent (83.4 percent), but is quickly being replaced by methyl chloroform. Other TCE applications include use in adhesives (2.1 percent), paints (1.4 percent), and PVC chain terminators. Miscellaneous applications include use as refrigerants and heat exchange liquids, and as a solvent for fats, greases and waxes and caffeine extraction (7%) (Slimak et al., 1980a). Table 7.2-21 gives a detailed breakdown of TCE end uses.

In 1980, three U.S. chemical companies produced TCE; none was located in California. Production of TCE decreased by 32 percent between 1974 and 1980, and by 12 percent between 1978 and 1980. (These percentages were derived from data in Slimak et al., 1980a and USITC, 1981).

7.2.18.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 264.5
imports (i) = 11.0
exports (e) = 55.1
availability (p) + (i) - (e) = 220.4

California: estimated availability = 25.7 (see Table 7.2-21)
estimated availability for solvent use = 24.0

Table 7.2-21

TRICHLOROETHYLENE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Direct Solvent Use:				
metal cleaning	83.4	183.9	12.5	23.0
textiles (scouring)	0.1	0.2	1.5	0.0
Use in Formulations:				
adhesives	2.1	4.6	10.7	0.5
paints	1.4	3.1	12.5	0.4
Other Uses:				
PVC chain terminator	6.0	13.2	NA	
miscellaneous	7.0	15.4	11.1[c]	1.7
Totals	100.0	220.4		25.6

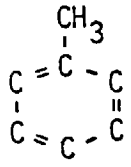
NA = Not applicable; negligible amounts used in California PVC production.

[a] Slimak et al., 1980a

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns, (USDOC, 1979a; USDOC, 1979b)
- metal cleaning SIC codes: (see Table 5.4-13)
- textile SIC code: 226
- adhesives SIC code: 2891
- paints SIC code: 2851

[c] NBL, 1981. National Business List figure for total California percent contribution to all marketing categories.

7.2.19 Toluene



7.2.19.1 Use and Production

Toluene is a Class II compound of medium volatility. The largest use of toluene is as a constituent in gasoline (45 percent). However, since toluene is a natural component in gasoline, this portion is not available for direct solvent use, use in formulations, or feedstock use. Toluene is also used as a feedstock for benzene (35 percent), isocyanates (4 percent), phenol (8 percent) and explosives manufacturing (1 percent) . Toluene is used in formulations including paints, lacquers, varnishes for coating metal cans and coil, paper coatings, inks, adhesives, and pharmaceuticals (7 percent) (Lee et al., 1979). Table 7.2-22 gives a breakdown of toluene end uses.

In 1980, 26 chemical companies manufactured toluene nationwide; at least one company was located in California and accounted for 0.9 percent of total national production. The annual toluene production rate remained constant during 1979 and 1980, but between 1971 and 1980 production increased 16 percent (Anon., 1982). Benzene and phenol were produced in California, but by processes that did not use toluene.

7.2.19.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 7,376.7
imports (i) = 551.1
exports (e) = 286.6
availability (p) + (i) - (e) = 7,641.2

California: estimated availability = 497.9 (57.8)* (see Table 7.2-22)
estimated availability for solvent use = 52.4

---

* Total minus amount in gasoline.

Table 7.2-22

TOLUENE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Use in Formulations:				
surface coating (paints; lacquers; varnishes for coating metal cans and coils; paper)	7	534.9	9.8	52.4
inks				
adhesives				
pharmaceutical mfr.				
Feedstock Uses:				
benzene mfr.	35	2674.4	NA[c]	
isocyanates production	4	305.6	NA[d]	
phenol mfr.	8	611.3	NA[e]	
explosives mfr.	1	76.4	7.1	5.4
Other Uses:				
gasoline pool	45	3438.5	12.8	440.1
Totals	100	7641.2		497.9 (57.8)[f]

[a] Lee et al., 1979

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns, (USDOC, 1979a; USDOC, 1979b)
surface coating, inks, adhesives and pharmaceutical mfr. SIC codes: 2851, 3411, 2641; 2893, 2891, 2834
explosives mfr. SIC code: 2892
gasoline pool SIC code: 2911

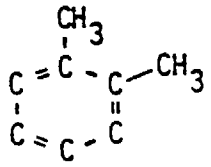
[c] NA = Not applicable; California benzene producers do not employ toluene deakylation or disproportionation.

[d] NA = Not applicable; not manufactured in California.

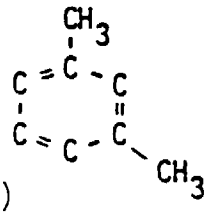
[e] NA = Not applicable; California phenol producers do not employ toluene oxidation.

[f] Total minus amount in gasoline pool; toluene is a natural component in gasoline and therefore is not available for [illegible] in formulations, feedstocks.

7.2.20 Xylene (mixed)



(ortho)



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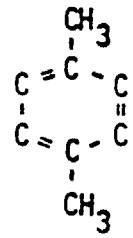


(para)

7.2.20.1 Use and Production

Xylene is a Class IV solvent of low volatility. Of the three isomers of xylene only o-xylene is used significantly as a solvent. The para isomer is used predominantly as a feedstock for manufacturing phthalic anhydride (PTA); isophthalic and tetrephthalic acid; xylidene; and dimethyl terephthalate (72 percent of mixed xylenes). Xylene is also used in paints, coatings, enamels and varnishes (9 percent); pesticides (9 percent); and gasoline (10 percent) (Lee et al., 1979). Table 7.2-23 gives a detailed breakdown of xylene end uses.

In 1980, 23 chemical companies produced xylene. Two producers were located in California. PTA was the only product for which xylene was used as a feedstock in California during 1980.

7.2.20.2 1980 Availability (10^6 lb)

U.S.: production (p) = 6,900.5
imports (i) = 341.7
exports (e) = 363.8
availability (p) + (i) - (e) = 6,878.4

California: estimated availability = 239.7 (151.7)* (see Table 7.2-23)
estimated availability for solvent use = 126.3

---

* Excludes amount in gasoline pool; since xylene is a natural component in gasoline it is not directly available for direct solvent use, use in formulations or as a feedstock.

Table 7.2-23

XYLENE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use[b]	Calif. Totals (10^6 lbs)
Use in Formulations:				
solvent in paints, coatings, enamels and varnishes	9	619.1	12.6	78.0
carrier in pesticides	9	619.1	7.8	48.3
solvent for pharmaceuticals	NA			
solvent for dyes	NA			
Feedstock Uses:				
phthalic anhydride mfr. (o-xylene) isophthalic acid mfr. (m-xylene) xylidene mfr. (antiknock additive) terephthalic acid (p-xylene) dimethyl terephthalate (p-xylene)	72	4952.4	-	25.4[c]

Table 7.2-23

XYLENE AVAILABILITY PROFILE

End Use Category	National Percent Use[a]	U.S. Totals (10^6 lbs)	California's Percent of National Use	Calif. Totals (10^6 lbs)
Other Uses:				
gasoline pool and miscellaneous	10	687.8	12.8	88.0
Totals	100	6878.4		239.7 (151.7)[d]

NA - not applicable; not manufactured in California
ND - no data available

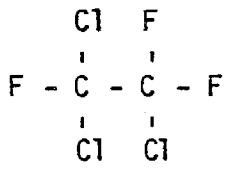
[a] Lee et al., 1979

[b] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC 1979b)
paint, coatings, enamels and varnish SIC codes: 2851, 2641
carrier in pesticides SIC code: 2879
gasoline pool SIC code: 2911

[c] phthalic anhydride (PTA) produced at Allied, El Segundo; capacity = 40×10^6 lbs, conversion factor (0.91 lbs o-xylene/lb PTA), assumed plant production = 70% (capacity); (40×10^6) $(0.7)(0.91) = 25.4 \times 10^6$ lbs

[d] Total minus amount in gasoline pool; xylene is a natural component in gasoline and therefore is not available for direct use, use in formulations, or feedstock use.

7.2.21 Trichlorotrifluoroethane



7.2.21.1 Use and Production

Trichlorotrifluoroethane (F-113) is a Class I compound of very high volatility. F-113 is used as a solvent for cleaning and degreasing (87 percent) and dry cleaning (3 percent). Other applications include use as a blowing agent in polyurethane foam, (3 percent) use as a refrigerant (3 percent) and in the synthesis of chlorotrifluoroacetate and polymer intermediates (4 percent) (Slimak and Katz, 1981). Table 7.2-24 gives a breakdown of F-113 end uses.

In 1980, four major companies produced F-113; none was located in California. A slow but steady growth rate of five or six percent from 1980 to 1983 is forecast for F-113 (Pitts, 1980).

5.4.21.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 131.7
imports (i) = 0.3
exports (e) = 9.7
availability (p) + (i) - (e) = 122.3

California: estimated availability = 15.1 (see Table 7.2-24); (17.0)*
estimated availability for solvent use = 14.0

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* One chemical company's estimate of total industry sales to California.

Table 7.2-24

TRICHLOROTRIFLUOROETHANE (F-113) AVAILABILITY PROFILE[a]

End Use Category	National Percent Use[b]	U.S. Totals (10^6 lb)	California's Percent of National Use[c]	Calif. Totals (10^6 lbs)
Direct Solvent Uses				
cleaning and degreasing	87	106.3	12.5	13.3
dry cleaning	3	3.7	9.6	0.4
Use in Formulations:				
refrigerants	3	3.7	9.3	0.3
Other Uses:				
foam blowing	3	3.7	11.1	0.4
misc. (synthesis of chlorotrifluoroacetate mfr.; polymer intermediates and other)	4	4.9	13.5[d]	0.7
Totals	100	122.3		15.1 (17.0)[e]

[a] Market balance was not performed for this chemical.

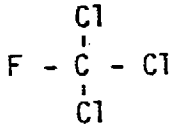
[b] Slimak and Katz, 1981.

[c] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b).
cleaning and degreasing SIC codes: (see Table 5.4-13)
dry cleaning SIC codes: 7215, 7216, 7218
refrigerants SIC code: 2899
foam blowing SIC code: 3079

[d] Miscellaneous: NBL, 1981. National Business List figure for California's percent contribution to U.S. manufacturing SIC codes

[e] One chemical company's estimate of total industry sales to California.

7.2.22 Fluorotrichloromethane



7.2.22.1 Use and Production

Fluorotrichloromethane (F-11) is a Class I compound of very high volatility. F-11 is used predominantly as a refrigerant (39 percent). Other applications include use in cleaning compounds, as a blowing agent in polyurethane foam (58 percent), and as an aerosol propellant (2 percent) (Pitts, 1980). Historically, F-11 (and all other fluorocarbons) were used mainly as aerosol propellants. Today, use of fluorocarbons in aerosols has been banned due to their contribution to stratospheric ozone depletion. Table 7.2-25 gives a breakdown of F-11 end uses.

In 1980, four major companies produced F-11; one company was located in California. Fluorocarbon use, including F-11, is expected to increase at a rate of five to six percent from 1980 to 1983 (Pitts, 1980).

7.2.22.2 1980 Availability (10^6 lbs)

U.S.: production (p) = 196.2
imports (i) = no data
exports (e) = 14.5
availability (p) + (i) - (e) = 181.7

California: estimated availability = 8.0 (see Table 7.2-25); (1.0)*
estimated availability for solvent use = 7.0

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* One chemical company's estimate of total industry sales to California.

Table 7.2-25

FLUOROTRICHLOROMETHANE (F-11) AVAILABILITY PROFILE[a]

End Use Category	National Percent Use[b]	U.S. Totals (10^6 lbs)	California's Percent of National Use[c]	Calif. Totals (10^6 lbs)
Use in Formulation:				
refrigerant	39	70.9	9.3	6.6
aerosol propellant	2	3.6	11.5	0.4
Other Uses:				
blowing agents for polyurethane foam	59	107.2	0.9	1.0
cleaning compounds misc. solvent uses				
Totals	100	181.7		8.0 (1.0)[d]

[a] Market balance was not performed for this chemical

[b] Pitts, 1980.

[c] California to U.S. SIC code ratios by number of employees from 1979 County Business Patterns (USDOC, 1979a; USDOC, 1979b)
refrigerant SIC code:2899
aerosol propellant SIC codes: 2841, 2842, 2844, 2851, 2879, 2891, 2899
blowing agent, cleaning compound SIC codes: 3079, 2842

[d] One chemical company's estimate of total industry sales to California.

7.3 USE OF SOLVENT SPECIES AND GROUPS BY INDUSTRY

At a number of the project meetings, ARB staff expressed an interest in information on the distribution of use of the different organic solvents among California industries. This information would be valuable in constructing species-specific emission inventories and in locating the sources of emissions of toxic and/or carcinogenic substances. Since the Standard Industrial Classification (SIC) code was known for each respondent in our EDS verification and direct industrial consumption and disposal surveys, it was a simple matter to arrange our results by industry. To facilitate presentation of our findings, solvents were placed in the following classes:

- Aliphatic hydrocarbons
- Aromatic hydrocarbons
- Chlorinated hydrocarbons
- Alcohols
- Glycols
- Ketones
- Glycol ethers
- Esters
- Fluorocarbons
- Paint and lacquer thinners
- Others

Aliphatic hydrocarbon solvents contained in thinners were not included in the first category. Note also that this compilation does not include any results of our analysis of indirect solvent consumption, which was presented in Chapter 6. Tables 7.3-1 through 7.3-11 show the industries in which different solvent species are used.

7.4 MARKET BALANCE SUMMARY

Using the methodology outlined in Section 5.1, we performed a market balance analysis on 20 organic solvent species. Table 7.4-1 summarizes our results. The total use of these chemicals in 1980 is estimated to be 907 million lb, or about 62 percent of the use of all solvents in the state, as estimated by this study. It may be recalled from Chapter 5 that the 20 chemicals summarized here were chosen on the basis of a preliminary estimate that they represented 95 percent of the solvent use in California. The reason for the large discrepancy in the predicted and actual percentages is that the

Table 7.3-1a

DIRECT INDUSTRIAL USE OF ALIPHATIC HYDROCARBON SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Cyclo-hexane	Hexane	Kerosene	Lactol Spirits	Mineral Spirits
1381	0	0	6	0	6
2044	0	0	3	0	0
2099	0	0	70	0	0
2032	0	0	3	0	802
2511	0	0	9	0	427
2512	0	0	0	0	35
2514	0	0	0	0	0
2521	0	0	0	0	17
2522	0	130	0	0	675
2531	0	0	0	0	0
2541	0	0	0	0	10
2591	0	0	0	0	93
2599	0	0	10	0	0
2641	0	16	0	0	0
2651	0	1,404	0	0	0
2751	0	0	3	0	588
2753	0	0	4	0	0
2819	0	0	0	0	11
2821	0	0	29	0	28,917
2834	0	6	0	0	0
2841	0	0	39	0	0
2842	336	0	767	12	1,407
2843	0	0	5	0	0
2844	0	0	8	0	3
2851	0	22	1,050	1,396	74,828
2869	0	0	72	0	0
2879	10	0	153	0	0
2891	0	4,033	757	0	20,400
2893	0	0	139	0	0
2899	0	44	947	74	198,391
2911	0	0	3,028	0	2,148
2952	0	0	0	0	11,855
2992	0	0	148	0	2,321
3069	0	0	6	0	0
3079	0	3	20	0	26
3361	0	0	75	0	0
3412	0	0	0	0	16
3423	0	0	11	0	0
3429	0	0	17	0	1
3479	0	0	0	0	78
3498	0	0	0	0	0
3541	0	0	5	0	0
3542	0	0	0	0	19
3599	0	0	17	0	0
3662	0	0	1	0	0
3711	0	0	44	0	0
3713	0	0	19	0	9
3714	0	0	68	0	2
3721	0	0	11	0	0
3728	0	0	956	0	1
3732	0	0	14	0	1
3751	0	0	26	0	2
3761	0	15	0	0	0
3822	0	0	0	456	0
Totals	346	5,673	8,540	1,938	343,089

Table 7.3-1b

DIRECT INDUSTRIAL USE OF ALIPHATIC HYDROCARBON SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Naphtha	Stoddard Solvent	VM&P Naphtha	140 Solvent	Other Aliphatics
1381	0	11	0	0	0
2291	0	2	0	0	0
2511	0	0	23	0	0
2514	0	0	59	0	0
2522	249	0	0	0	0
2591	0	0	1,601	0	0
2641	19,279	0	0	0	0
2651	0	349	0	0	0
2711	61	0	0	0	0
2819	0	4	0	0	0
2821	0	0	2,262	0	0
2842	0	36	91	0	0
2843	0	1	0	0	0
2851	19,424	0	17,600	1,899	18,894
2869	5,566	16	0	0	0
2879	288	1	0	0	0
2891	0	0	4,293	0	912[a]
2899	1,192	11	337	0	0
2911	44	24	0	15	2[b]
3011	361	0	0	0	0
3069	0	0	82	0	0
3079	63	17	124	0	0
3423	2	23	0	0	0
3429	0	6	85	0	0
3432	0	170	0	0	0
3471	0	0	330	0	0
3479	0	0	35	0	5,217
3541	0	15	0	11	0
3561	0	4	0	0	0
3662	87	0	0	0	0
3711	605	5	0	0	2,785
3714	0	17	0	73	0
3721	0	54	0	0	0
3724	0	62	0	0	0
3728	29	15	0	0	0
3751	0	14	0	0	0
3761	7	0	0	0	0
3822	72	0	0	0	0
3861	0	22	0	0	0
Totals	47,329	879	26,922	1,998	27,810

[a] Heptane; projection based on one company.

[b] Isooctane; based on one company.

Table 7.3-1c

DIRECT INDUSTRIAL USE OF ALIPHATIC HYDROCARBON SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Aliphatic Hydrocarbons (initial boiling point >150°C)[a]	Aliphatic Hydrocarbons (initial boiling point <150 °C)[b]
2511	107	0
2514	133	0
2522	197	0
2751	0	19,261
2819	4	0
2821	680	0
2841	4	0
2842	545	10
2851	5,523	1,068
2891	487	0
2899	553	0
2992	373	0
3011	0	39
3079	160	0
3111	0	161
3411	144	0
3412	18	0
3421	28	0
3429	159	0
3432	15	0
3444	1	0
3479	1,437	0
3541	373	0
3544	198	0
3714	28	0
4511	160	0
Totals	11,327	20,539

[a] Initial boiling point ranges for this data: 154 to 207 °C.

[b] Initial boiling point ranges for this data: 93 to 124 °C.

Table 7.3-2

DIRECT INDUSTRIAL USE OF AROMATIC HYDROCARBON SOLVENTS IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Xylene	Toluene	Ethyl Benzene	Other Aromatics
2434	0	26	0	0
2511	0	0	0	0
2512	0	13	0	0
2521	0	19	0	0
2522	127	177	39	0
2541	0	51	0	0
2591	6	0	0	0
2599	0	10	0	0
2641	142	1,439	0	0
2651	132	1,847	0	0
2711	114	0	0	0
2751	44	557	0	0
2753	0	0	0	0
2819	0	2	0	0
2821	1,573	2,299	410	54
2822	0	0	0	31
2833	49	1	0	0
2834	0	19	0	0
2842	79	111	0	58
2844	1	0	0	0
2851	13,398	25,662	58	2,443
2869	1,837	3	0	0
2879	11,549	0	0	0
2891	70	3,440	0	0
2892	0	0	0	0
2893	2	371	0	0
2899	613	675	0	1,679
2911	284	333	0	0
2992	1,065	0	0	0
3041	0	19	0	0
3069	3	1,348	0	0
3079	504	45	0	0
3111	0	516	0	0
3231	0	113	0	0
3411	40	89	0	0
3423	0	1	0	0
3479	43	83	0	0
3541	0	0	0	0
3699	0	2	0	0
3711	23	73	0	0
3713	0	20	0	0
3714	7	12	0	0
3721	1	32	0	0
3728	2	31	0	0
3732	0	1	0	0
3761	0	2	0	0
3764	0	5	0	0
3792	0	17	0	0
3841	0	0	0	0
3842	513	0	0	0
3851	10	0	0	0
3861	365	232	0	0
3949	0	61	0	0
Totals	32,596	39,757	507	4,265

Table 7.3-3

DIRECT INDUSTRIAL USE OF CHLORINATED HYDROCARBON SOLVENTS IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Chloro-benzene	Ethylene Dichloride	Methyl Chloroform	Methylene Chloride	Perchloro-ethylene[a]	Trichloro-ethylene
2095	0	0	0	0	0	9
2291	0	0	2	0	0	0
2295	0	0	0	0	1,474	0
2512	0	0	74	0	0	0
2514	0	0	0	80	556	0
2521	0	0	57	0	0	0
2522	0	0	121	4	0	0
2599	0	0	7	0	0	0
2641	0	0	0	0	45	0
2751	0	0	77	487	1,045	0
2754	0	0	0	0	7	0
2813	0	0	7	0	0	0
2819	0	31	3	0	0	0
2821	16	186	287	1,711	0	12
2822	0	0	19	593	0	0
2833	0	0	0	3	0	0
2834	0	0	58	206	2	0
2841	0	0	0	32	0	0
2842	0	0	135	913	344	0
2843	0	0	4	0	0	0
2844	0	0	0	1	0	0
2851	0	9	373	7,756	147	73
2869	0	0	8	0	2	0
2879	0	10	0	4	0	0
2891	0	0	5,736	1,025	21	361
2892	0	0	20	0	0	0
2899	0	0	546	5,456	101	296
2911	0	9	0	0	0	0
2992	0	0	143	1,703	0	0
3069	0	0	45	92	470	7
3079	0	3	212	138	14	211
3421	0	0	535	0	0	0
3423	0	0	1	0	1	3
3425	0	0	94	0	0	0
3429	0	0	2,180	0	114	0
3431	0	0	0	12	0	0
3432	0	0	888	0	598	0
3444	0	0	0	0	1,675	0
3452	0	0	3,486	0	0	0
3469	0	0	0	0	0	0
3471	0	0	0	0	2,737	0
3479	0	0	547	898	227	30
3541	0	0	2,408	0	0	0
3542	0	0	0	0	37	0
3589	0	0	1,045	0	0	0

Table 7.3-3

DIRECT INDUSTRIAL USE OF CHLORINATED HYDROCARBON SOLVENTS IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)
(Continued)

SIC Code	Chloro-benzene	Ethylene Dichloride	Methyl Chloroform	Methylene Chloride	Perchloro-ethylene[a]	Trichloro-ethylene
3662	0	0	12	0	0	0
3679	0	0	15,755	13,117	0	0
3699	0	0	45	0	7	12
3711	0	0	0	310	94	0
3714	0	0	307	0	1,271	168
3721	0	0	685	13	6	0
3724	0	0	249	8	766	0
3728	0	0	77	0	0	8
3732	0	0	0	22	0	0
3751	0	0	6	34	0	0
3761	0	0	2,679	196	0	0
3769	0	0	1	0	1,976	1
3811	0	0	0	0	0	0
3822	0	0	629	58	10	0
3832	0	0	30	5	0	0
3841	0	0	0	74	0	0
3842	0	0	0	29	0	0
3851	0	0	46	593	0	0
3861	0	0	549	166	84	0
3949	0	0	46	0	10	0
4511	0	0	1,526	0	0	0
7899	0	0	2,126	0	0	0
Totals	16	248	41,634	35,739	13,841	1,191

[a] Excludes use of perchloroethylene for dry cleaning, including industrial laundering.

DIRECT INDUSTRIAL USE OF ALCOHOL SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Butyl Alcohol	Ethyl Alcohol	Isobutyl Alcohol	Isopropyl Alcohol	Furfuryl Alcohol	Methyl Alcohol	Propyl Alcohol	Texanol	Other Alcohols
2045	0	1	0	0	0	0	0	0	0
2079	0	1	0	0	0	0	0	0	0
2086	0	143	0	0	0	0	0	0	0
2511	0	0	0	3	0	40	0	0	0
2514	27	0	0	0	0	0	0	0	0
2522	0	0	200	0	0	0	0	0	0
2541	0	0	0	0	0	3	0	0	0
2599	0	0	0	2	0	0	0	0	0
2641	2	620	0	532	0	0	2	0	0
2643	0	0	0	0	0	0	4,099	0	0
2651	0	347	0	0	0	0	0	0	0
2751	222	477	0	506	0	0	0	0	0
2753	0	0	0	9	0	0	0	0	0
2754	0	0	0	0	0	0	3	0	0
2819	0	15	0	53	0	15	0	0	0
2821	121	1,609	10	49	194	28	0	0	0
2831	0	0	0	1,579	0	508	0	0	0
2833	7	0	0	589	0	91	0	0	0
2834	0	12,297	0	19,099	0	286	0	0	0
2841	187	38	0	128	0	0	0	0	
2842	4	0	0	284	0	64	3	0	0
2843	0	0	0	120	0	0	0	0	0
2844	4	31,628	0	2,069	0	181	0	0	0
2851	6,669	1,592	959	11,481	0	3,963	73	3,013	2,174[d]
2869	1	21	0	2,263	0	2,381	0	0	1[b]
2879	0	0	0	297	0	15	0	0	0
2891	39	31	0	221	8	149	7	0	0

Table 7.3-4

DIRECT INDUSTRIAL USE OF ALCOHOL SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)
(Continued)

SIC Code	Butyl Alcohol	Ethyl Alcohol	Isobutyl Alcohol	Isopropyl Alcohol	Furfuryl Alcohol	Methyl Alcohol	Propyl Alcohol	Texanol	Other Alcohols
2893	0	0	0	5	0	356	0	10	48[c]
2899	141	7	132	429	0	272	3	0	1[d]
2911	0	0	0	6	0	6	5	0	0
2992	0	0	0	533	0	0	0	0	0
3079	0	227	0	2,727	0	99	202	0	0
3111	0	0	0	258	0	0	0	0	0
3361	0	0	0	19	0	0	0	0	0
3411	53	0	0	0	0	0	0	0	0
3412	9	1	0	9	0	0	0	0	0
3423	0	0	0	6	0	0	0	0	0
3429	0	0	0	4	0	0	0	0	0
3431	0	0	0	0	0	3	0	0	0
3432	0	0	0	14	0	0	0	0	0
3471	0	0	46	0	0	171	0	0	0
3479	0	0	0	802	0	32	0	0	0
3541	0	0	0	0	0	0	0	0	0
3674	0	0	0	0	0	37	0	0	0
3699	0	22	0	14	0	14	0	0	0
3711	0	0	0	0	0	0	0	0	0
3714	0	0	0	10	0	3	0	0	0
3721	0	0	0	10	0	0	0	0	0
3728	0	1	0	17	0	0	0	0	0
3761	0	0	0	143	0	0	0	0	0
3764	0	0	0	6	0	0	0	0	0
3769	0	0	0	1	0	0	0	0	0
3811	0	0	0	230	0	0	0	0	0
3822	0	54	0	0	0	0	0	0	0
3832	0	0	0	1	0	0	0	0	0

Table 7.3-4

DIRECT INDUSTRIAL USE OF ALCOHOL SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)
(Continued)

SIC Code	Butyl Alcohol	Ethyl Alcohol	Isobutyl Alcohol	Isopropyl Alcohol	Furfuryl Alcohol	Methyl Alcohol	Propyl Alcohol	Texanol	Other Alcohols
3841	1	113	0	2	0	8	0	0	0
3842	0	0	0	232	0	0	0	0	0
3851	0	0	0	1	0	160	0	0	64[e]
3861	0	49	0	339	0	0	0	0	0
3949	0	26	0	0	0	0	0	0	0
Totals	7,487	49,320	1,347	45,102	202	8,885	4,397	3,023	2,288

[a] Mixed alcohols; projections based on two companies

[b] Methyl amyl alcohol; based on one company

[c] Tridecyl alcohol (552%), Anhydrol (48%); based on two companies

[d] 2-ethylhexanol

[e] Denatured alcohol

Table 7.3-5

DIRECT INDUSTRIAL USE OF GLYCOL SOLVENTS IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Diethylene Glycol	Ethylene Glycol	Hexylene Glycol	Propylene Glycol	Other Glycols
2086	0	0	0	5	0
2641	0	11	0	0	0
2819	2	1	0	0	0
2821	0	0	0	0	0
2822	365	0	0	0	0
2834	0	2	0	61	0
2841	0	0	0	3	0
2842	0	29	0	0	0
2843	0	4	1	0	0
2844	0	0	0	1,571	0[a]
2851	203	5,253	11	3,314	2,160[b]
2869	0	24	22	6	1
2879	33	0	3	248	0[c]
2891	0	110	0	28	2[d]
2893	118	270	27	141	7[b]
2899	16	277	16	65	2
2911	0	107	0	0	0
2952	0	0	0	336	0
2992	13	0	14	0	0
3031	1	0	0	0	0
3069	7	71	0	0	0
3079	0	50	0	18	0
3423	0	1	0	0	0
3711	0	0	0	0	0
3792	0	27	0	8	0
3811	12	0	0	0	0
Totals	770	6,237	94	5,804	2,172

[a] "Mixed glycols" (98%), dipropylene glycol (2%); projections based on two companies.

[b] Triethylene glycol

[c] Polypropylene glycol

[d] Dipropylene glycol

Table 7.3-6

DIRECT INDUSTRIAL USE OF KETONE SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Acetone	Methyl Ethyl Ketone	Methyl Isobutyl Ketone	Cyclohex-anone	Mesityl Oxide	Diacetone Alcohol	Isophorone	Other Ketones
1799	57	0	0	0	0	0	0	0
2434	0	148	0	0	0	0	0	0
2511	190	0	0	0	0	0	0	0
2519	15	0	0	0	0	0	0	0
2521	17	13	0	0	0	0	0	0
2522	45	93	0	0	0	0	0	0
2541	8	2	0	0	0	0	0	0
2591	8	0	0	0	0	0	0	0
2599	23	0	0	0	0	0	0	0
2641	801	405	0	0	0	0	0	0
2651	0	767	0	0	0	0	0	0
2751	139	280	0	0	0	0	0	0
2753	1	0	0	0	0	0	0	0
2819	23	0	4	0	0	0	0	0
2821	551	1,043	2	1	0	128	0	282[a]
2822	0	0	0	0	0	0	0	0
2831	2	0	0	0	0	0	0	0
2833	92	0	0	0	0	0	0	0
2834	439	1	0	17	0	0	0	0
2842	124	13	0	0	0	0	0	0
2844	20	0	0	0	0	0	0	0
2851	20,394	16,225	2,823	1,016	0	2,318	271	3,682[b]
2869	2	250	0	0	4,036	0	0	0
2879	51	37	14	353	0	0	0	0
2891	1,323	7,573	6	891	0	0	0	8[c]
2892	5	1	0	0	0	0	0	0
2893	694	383	10	0	0	0	0	0
2899	162	202	2,633	0	0	0	0	0

Table 7.3-6

DIRECT INDUSTRIAL USE OF KETONE SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)
(Continued)

SIC Code	Acetone	Methyl Ethyl Ketone	Methyl Isobutyl Ketone	Cyclohex-anone	Mesityl Oxide	Diacetone Alcohol	Isophorone	Other Ketones
2911	41	0	0	0	0	0	0	0
2992	280	0	3	0	15	0	0	0
3069	0	45	0	0	0	0	0	0
3079	10,787	3,794	0	2	0	0	0	0
3111	0	399	0	0	0	0	0	0
3411	502	152	13	31	0	0	0	0
3412	27	115	0	0	0	41	0	0
3423	1	1	0	0	0	0	0	0
3429	2	29	0	2	0	0	0	0
3431	2	0	0	0	0	0	0	0
3471	46	0	0	0	0	0	0	0
3479	19,876	18,836	0	199	0	0	0	0
3498	195	0	0	0	0	0	0	0
3541	0	0	0	0	0	0	0	0
3542	1	0	0	0	0	0	0	0
3634	0	0	0	0	0	0	0	0
3662	0	0	0	0	0	0	0	0
3679	0	55	0	0	0	0	0	0
3699	24	5	0	0	0	0	0	0
3711	184	9	1	0	0	0	0	1,794[d]
3714	29	44	0	0	0	0	0	0
3721	19	84	0	0	0	0	0	0
3724	0	70	0	0	0	0	0	0
3728	194	163	0	0	0	0	0	0

Table 7.3-6

DIRECT INDUSTRIAL USE OF KETONE SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)
(Continued)

SIC Code	Acetone	Methyl Ethyl Ketone	Methyl Isobutyl Ketone	Cyclohex-anone	Mesityl Oxide	Diacetone Alcohol	Isophorone	Other Ketones
3732	2,431	18	0	0	0	0	0	0
3751	5	0	0	0	0	0	0	0
3761	36	1,877	0	14	0	0	0	0
3764	0	94	0	0	0	0	0	0
3769	2	76	0	0	0	0	0	0
3792	95	0	0	0	0	0	0	0
3811	6	1	0	0	0	0	0	0
3822	83	0	0	0	0	0	0	0
3832	2	0	0	0	0	0	0	0
3841	6	0	0	0	0	0	0	0
3842	420	0	0	10	0	0	0	0
3851	8	0	0	0	0	0	0	0
3861	1	4,926	0	0	0	0	0	0
3949	258	58	0	0	0	0	0	0
Totals	60,749	58,287	5,509	2,536	4,051	2,487	271	5,766

[a] Methyl amyl ketone; projection based on one company reporting.

[b] Mixed ketones; mainly methyl amyl ketone and mixed; projection based on five companies.

[c] Pentoxone; projection based on one company.

[d] Mixed ketones; projection based on one company.

Table 7.3-7

DIRECT INDUSTRIAL USE OF GLYCOL ETHER SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Diethylene Glycol Mono-butyl Ether	Diethylene Glycol Mono-ethyl Ether	Ethylene Glycol Mono-butyl Ether	Ethylene Glycol Mono-ethyl Ether	Ethylene Glycol Mono-methyl Ether	Other Glycol Ethers
2032	0	0	43	0	0	0
2511	0	0	60	0	0	0
2522	0	0	702	0	0	0
2541	0	0	0	26	0	0
2641	0	0	0	50	0	0
2651	0	0	0	59	0	0
2711	0	0	0	15	0	0
2751	0	0	102	810	0	0
2754	0	0	0	4	0	0
2821	6	0	106	0	0	0
2841	0	0	855	0	0	0
2842	0	0	805	7	517	0
2843	0	0	107	0	0	0
2844	0	0	7	0	0	0
2851	1,754	18	7,517	2,076	83	1,164[a]
2869	0	0	28	771	0	0
2879	0	6	0	0	0	0
2891	0	11	0	8	0	22[b]
2893	0	0	0	58	0	0
2897	0	0	10	0	0	0
2899	68	16	792	713	0	0
3079	0	0	0	0	2,658	0

Table 7.3-7

DIRECT INDUSTRIAL USE OF GLYCOL ETHER SOLVENTS IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)
(Continued)

SIC Code	Diethylene Glycol Monobutyl Ether	Diethylene Glycol Monoethyl Ether	Ethylene Glycol Monobutyl Ether	Ethylene Glycol Monoethyl Ether	Ethylene Glycol Monomethyl Ether	Other Glycol Ethers
3411	0	0	0	0	17	0
3412	0	0	2	0	0	0
3471	0	0	1,096	0	0	0
3479	0	0	10	0	3	2,188[c]
3711	0	0	798	0	0	0
3728	0	0	0	1	0	0
3861	0	0	0	69	0	0
Totals	1,828	51	13,039	4,667	3,278	3,374

[a] "Glycol ethers" (82%), diethylene glycol monomethyl ether (13%), brand name blycol ether (5%); projections based on two companies.

[b] Diethylene glycol monomethyl ether; based on one company.

[c] Ethylene glycol monophenyl ether; based on one company.

Table 7.3-8

DIRECT INDUSTRIAL USE OF ESTER SOLVENTS IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Amyl Acetate	Butyl Acetate	Butyl Carbitol Acetate	Butyl Cellosolve Acetate	Cellosolve Acetate	Ethyl Acetate	Isobutyl Acetate	Isopropyl Acetate	Propyl Acetate	Other Acetate
2514	0	0	0	10	2	0	0	9	0	0
2522	93	127	0	0	73	0	45	0	0	0
2641	0	0	0	0	0	326	0	0	0	0
2651	0	0	0	0	0	2019	0	0	135	0
2751	0	100	0	0	0	1,053	0	0	0	0
2821	0	1,253	0	0	13	0	0	2	0	0
2824	0	0	0	0	0	0	0	0	0	0
2842	0	11	0	0	0	0	0	0	0	0
2844	0	0	0	0	0	10	0	0	0	0
2851	83	6,114	167	1,363	12,253	828	6,945	547	243	3,128[a]
2869	0	0	0	0	0	0	0	1	0	0
2879	33	0	0	0	0	0	0	0	0	0
2891	0	185	0	25	35	131	4	0	0	0
2893	0	0	0	0	0	0	0	0	0	0
2899	0	0	0	0	135	55	0	0	0	0
2992	0	0	0	0	0	0	0	0	0	0
3079	0	0	0	0	0	0	0	0	1	0
3111	0	0	0	0	0	0	354	0	0	0
3411	0	22	0	0	0	0	0	0	0	0
3412	0	1	0	0	24	0	0	0	0	7[b]
3429	0	0	0	0	74	0	0	0	0	0
3471	0	53	0	0	1,064	0	0	0	0	0
3479	0	24	0	0	6	0	0	0	0	0
3699	0	0	0	0	1	25	0	0	0	0
3711	0	0	0	0	1,924	0	0	1,810	0	505[c]
3714	0	0	0	0	10	0	10	0	0	0
3816	0	160	0	0	0	747	0	0	0	0
Totals	209	8,050	167	1,398	15,614	5,194	7,358	2,369	379	3,640

[a] Glycol ether acetates (23%), mixed esters (77%); projection based on two companies.

[b] Diethylene glycol monoethyl ether acetate; projection based on one company.

[c] Mixed esters; based on one company.

Table 7.3-9

DIRECT INDUSTRIAL USE OF FLUOROCARBON SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE[a]
(Use in 1000 lb)

SIC Code	Fluorocarbon 11	Fluorocarbon 113	Other Fluorocarbons
2322	10,500	0	0
2821	1,277	0	0
2844	0	28	0
2899	3	2	0
2992	0	10	0
3423	0	5	0
3479	0	41	0
3674	0	104	0
3699	2	0	0
3721	0	13	0
3728	0	73	0
3761	0	1,719	0
3832	0	15	0
3842	0	66	0
3851	0	86	13,291[c]
9711[b]	0	0	0
Totals	11,782	2,162	13,291

[a] Does not include uses in the dry cleaning industry.

[b] Military base

[c] "Freons" (81%), bromochloromethane (19%); based on one respondent.

Table 7.3-10

DIRECT INDUSTRIAL USE OF THINNERS IN CALIFORNIA, 1980, BY SIC CODE[a]
(Use in 1000 lb)

SIC Code	Lacquer Thinner	Paint Thinner
2086	0	2
2451	0	472
2511	564	919
2512	72	43
2514	0	18
2521	86	66
2522	21	11202
2531	27	0
2541	268	24
2542	6	0
2591	0	43
2599	4	0
2751	184	4
2753	2	0
2842	497	0
2851	12,239	0
2891	94	0
3079	114	0
3412	0	82
3421	81	0
3429	19	0
3432	0	53
3479	92	265
3711	96	3
3713	0	110
3714	3	1
3724	1	0
3728	8	0
3731	0	148
3732	0	31
3761	0	43
3769	0	6
3792	10	0
3799	0	66
3822	28	0
3861	23	0
3949	455	0
3999	0	216
Totals	14,994	3,817

[a] Constituents of a typical thinner include: aliphatic (40%), alcohol (25%), ketone (20%), aromatic (15%).

Table 7.3-11

DIRECT INDUSTRIAL USE OF OTHER SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)

SIC Code	Dimethyl Formamide	Propylene Oxide	Isobutyl Isobutyrate	Triethanol-amine	Others
1381	0	0	0	0	214
2079	0	0	0	0	2
2099	0	0	0	0	215
2521	0	0	0	0	269
2522	0	0	0	0	206
2541	0	0	0	0	7
2542	0	0	0	0	24
2599	0	0	0	0	13
2751	0	0	0	0	104
2754	0	0	0	0	2
2819	0	0	0	165	401
2821	0	0	0	0	817
2822	10	2,333	0	0	0
2831	537	1,864	0	0	0
2834	0	0	0	0	6
2841	0	0	0	154	0
2842	0	0	0	6	5
2843	0	0	0	0	286
2844	0	0	0	55	41
2851	1,887	1	1,905	155	6,494
2869	0	0	0	1	0
2879	35	2	0	8	481
2891	945	0	0	1	8,509
2893	0	0	0	0	1,031
2899	0	0	0	150	45
2911	0	0	0	0	2,432

Table 7.3-11

DIRECT INDUSTRIAL USE OF OTHER SOLVENTS
IN CALIFORNIA, 1980, BY SIC CODE
(Use in 1000 lb)
(Continued)

SIC Code	Dimethyl Formamide	Propylene Oxide	Isobutyl Isobutyrate	Triethanol-amine	Others
2992	0	0	0	44	284
3031	0	0	0	0	2
3069	0	0	0	0	9
3079	2,961	0	0	0	110
3411	0	0	0	0	222
3412	0	0	0	0	429
3429	0	0	0	0	70
3432	0	0	0	0	62
3442	0	0	0	0	150
3444	0	0	0	0	1,642
3479	0	0	0	0	378
3589	0	0	0	0	44
3713	0	0	0	0	21
3714	0	0	0	0	44
3728	0	0	0	0	5,198
3851	0	0	0	0	58
3861	0	0	0	77	472
3949	0	0	0	0	295
Totals	6,275	4,200	1,905	816	31,094

Table 7.4-1

CALIFORNIA MARKET BALANCE SUMMARY HIGHLIGHTS, 1980, FOR SELECTED CHEMICALS[a]
(in 1000 lb)

Chemical	Direct Industrial Use[b]	Use of Formulations In-State[c]	Total Use	Recycled	Disposed	Emissions[d] Process	Use[e]	Total
Acetone	60,751	15,512	76,263	4,935	9,221	425	35,717	36,142
Butyl acetate	8,051	10,128	18,179	6	1	151	9,898	10,049
Butyl alcohol	7,486	9,607	17,093	32	1	143	8,677	8,820
Ethyl acetate	5,195	11,372	16,567	0	565	20	13,620	13,640
Ethyl alcohol	49,320	22,746	72,066	43	417	936	23,092	24,028
Ethylene glycol	6,236	171,357	177,593	2	156,754	121	14,705	14,826
Ethylene glycol monobutyl ether	13,039	10,500	23,539	734	130	203	11,106	11,309
Ethylene glycol monoethyl ether	4,669	13,402	18,071	6	111	72	12,885	12,957
Isopropyl alcohol	45,105	15,360	60,465	87	4,864	695	18,789	19,484
Methyl alcohol	8,887	25,027	33,914	192	266	143	24,445	24,588
Methyl chloroform	41,634	1,207	42,841	6,333	184	138	26,407	26,545
Methylene chloride	35,739	1,080	36,819	5,112	785	343	12,018	12,361
Methyl ethyl ketone	58,290	38,382	96,672	896	248	495	60,178	60,673
Methyl isobutyl ketone	5,510	12,101	17,611	3	4	110	10,433	10,543
Perchloroethylene	13,838	102	13,940	1,883	253	10	8,995	9,005
Propyl alcohol	4,399	1	4,400	5	10	2	4,200	4,202
Propylene glycol	5,804	4,317	10,121	3	0	115	4,335	4,450
Toluene	39,758	50,613	90,371	957	186	638	51,172	51,801
Trichloroethylene	1,193	96	1,289	35	216	15	269	284
Xylene	32,595	46,824	79,419	272	824	595	45,098	45,693
Totals	447,499	459,734	907,233	21,536	175,040	5,370	396,039	401,409

[a] Unless otherwise stated, all data are from SAI direct industrial solvent consumption and disposal survey (see Section 5.3).

[b] Does not include feedstock uses.

[c] Sum of in-state manufactured formulation use plus out-of-state imported formulation use. See Table 6.6-1.

[d] Emissions were estimated by the methods presented in Section 5.4.

[e] Use Emissions = Emissions from (direct use by formulators) + (direct use by non-formulators) + (use in formulations).

former value was based upon national use patterns, while the latter represents actual use patterns in California.

As a group, these 20 solvents are used about equally as individual chemical species and as ingredients in formulations. It is interesting to note that reported disposal represents about 19 percent of total purchase. Disposal of ethylene glycol used in radiator antifreeeze constitues the bulk of this figure. Only about 4.8 percent of the direct industrial use is recycled. Chemicals which are recycled to the greatest extent by direct industrial users include the chlorinated hydrocarbons 1,1,1-trichloroethane (15.2 percent), methylene chloride (14.3 percent) and perchloroethylene (13.6 percent). These high recycling rates are probably due to the high price of these solvents.

Use of the 20 market balance chemicals is estimated to result in process and direct use emissions of 2,700 and 198,000 tons, respectively, for a total of 200,700 tons. Solvents responsible for the largest amounts of emissions include methyl ethyl ketone, toluene, xylene, acetone, methyl chloroform (1,1,1-trichloroethane), methanol and ethanol. Market balance summaries for the individual solvent species are shown in Figures 7.4-1 through 7.4-20.

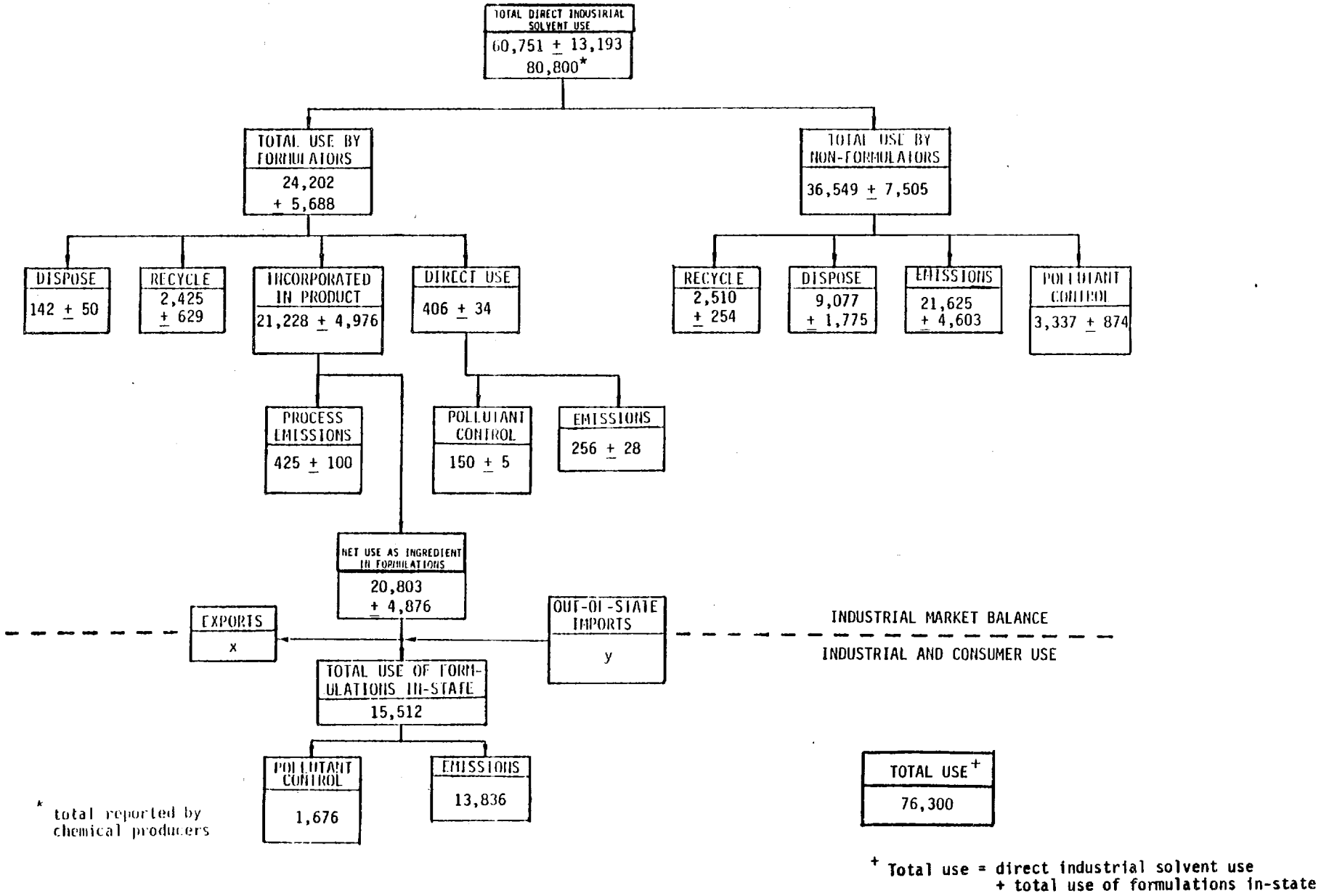

Figure 7.4-1. Market Balance Summary for Acetone, 1980 (in 1000 lb).

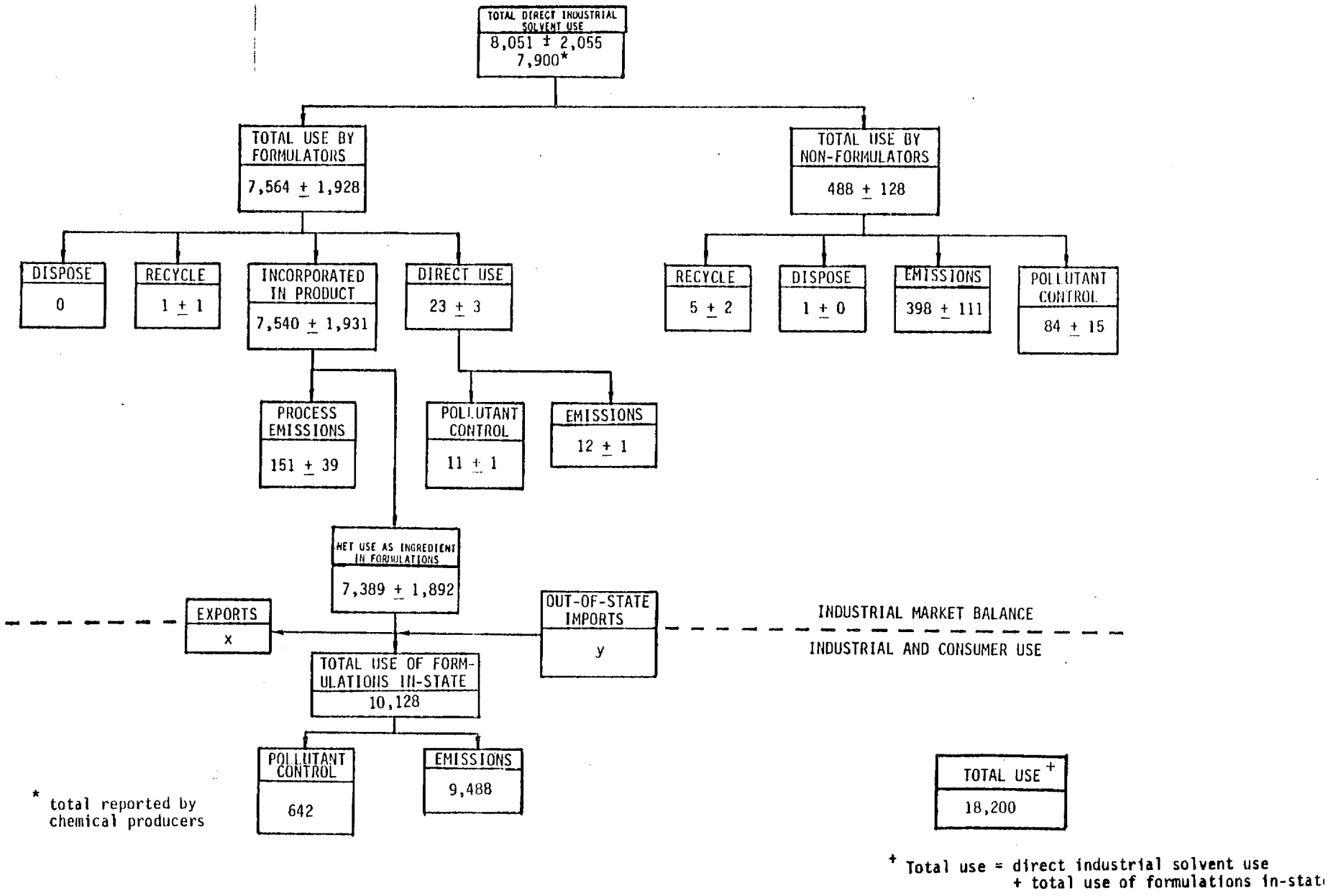

Figure 7.4-2. Market Balance Summary for n-Butyl Acetate, 1980 (in 1000 lb).

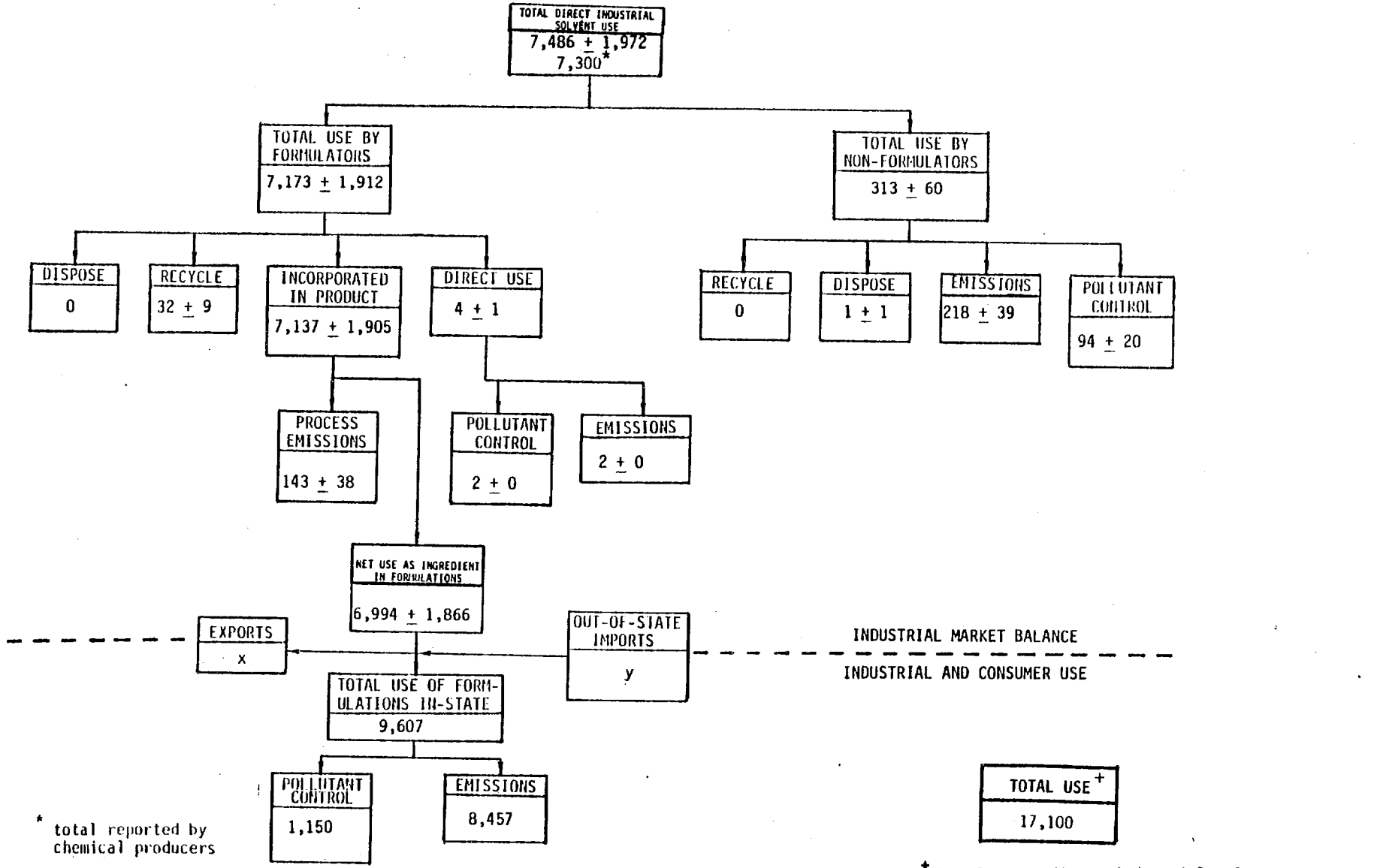

Figure 7.4-3. Market Balance Summary for n-Butyl Alcohol, 1980 (in 1000 lb).

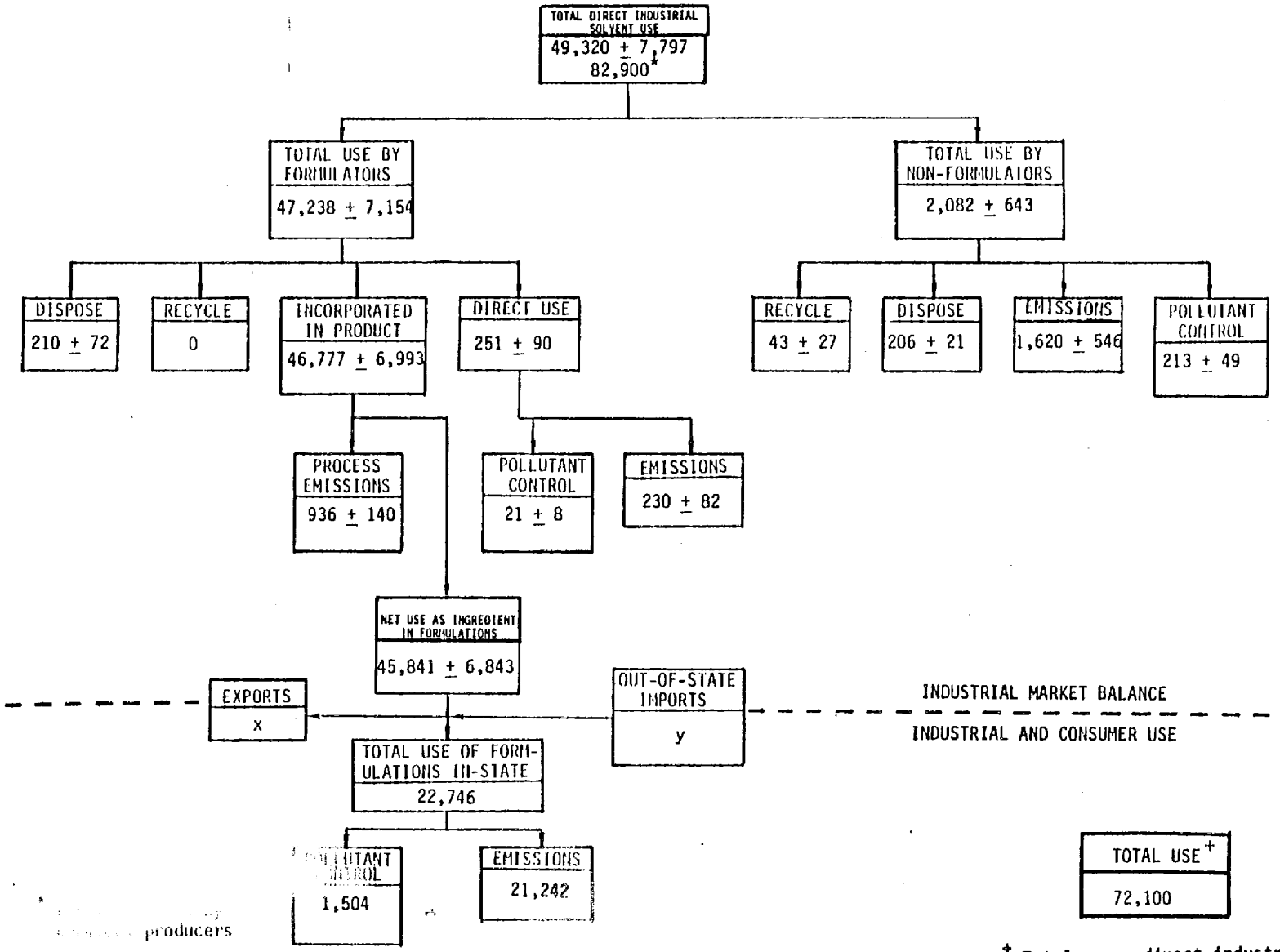

Figure 7.4-4. Market Balance Summary for Ethanol, 1980 (in 1000 lb).

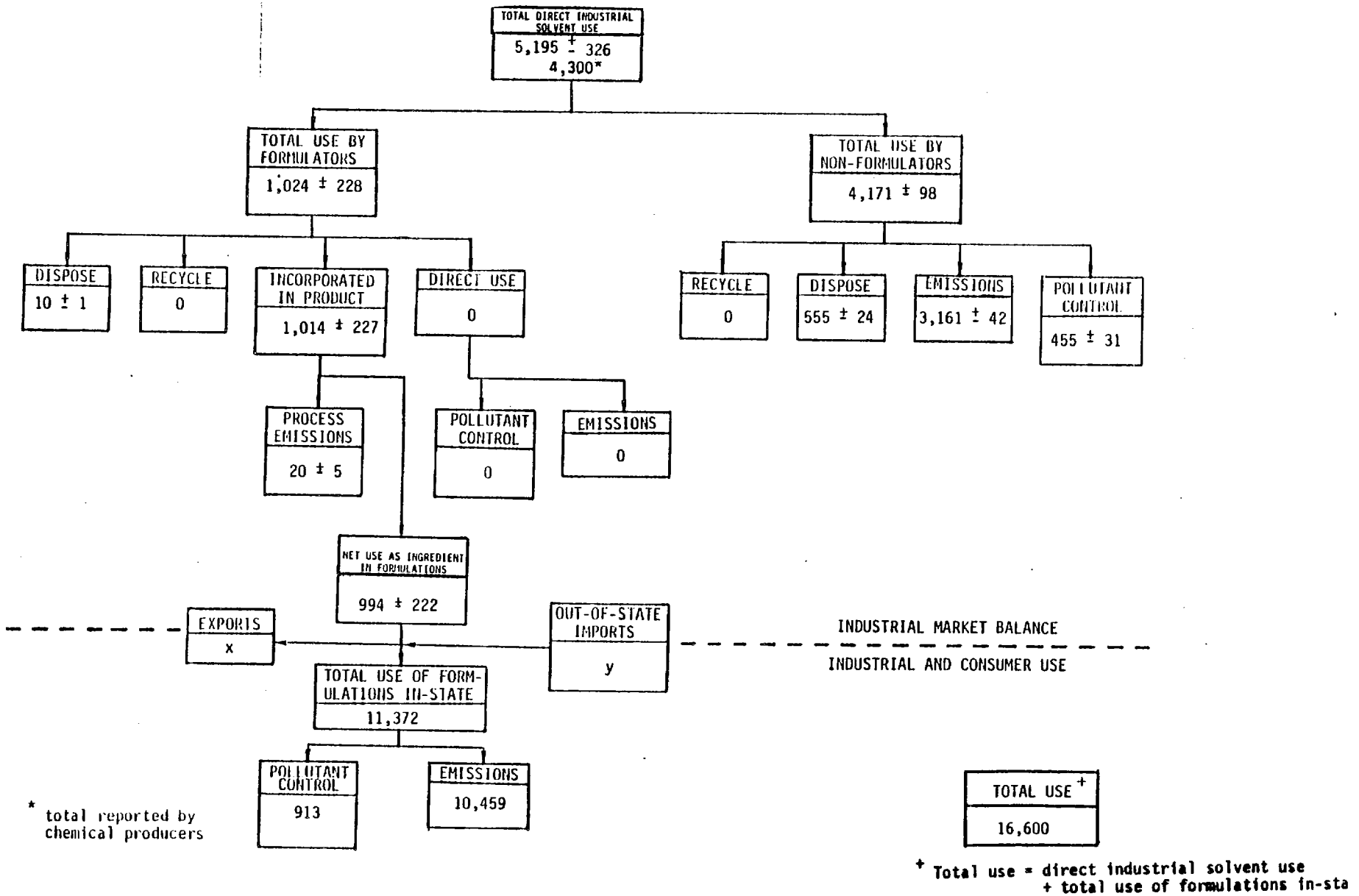

Figure 7.4-5. Market Balance Summary for Ethyl Acetate, 1980 (in 1000 lb).

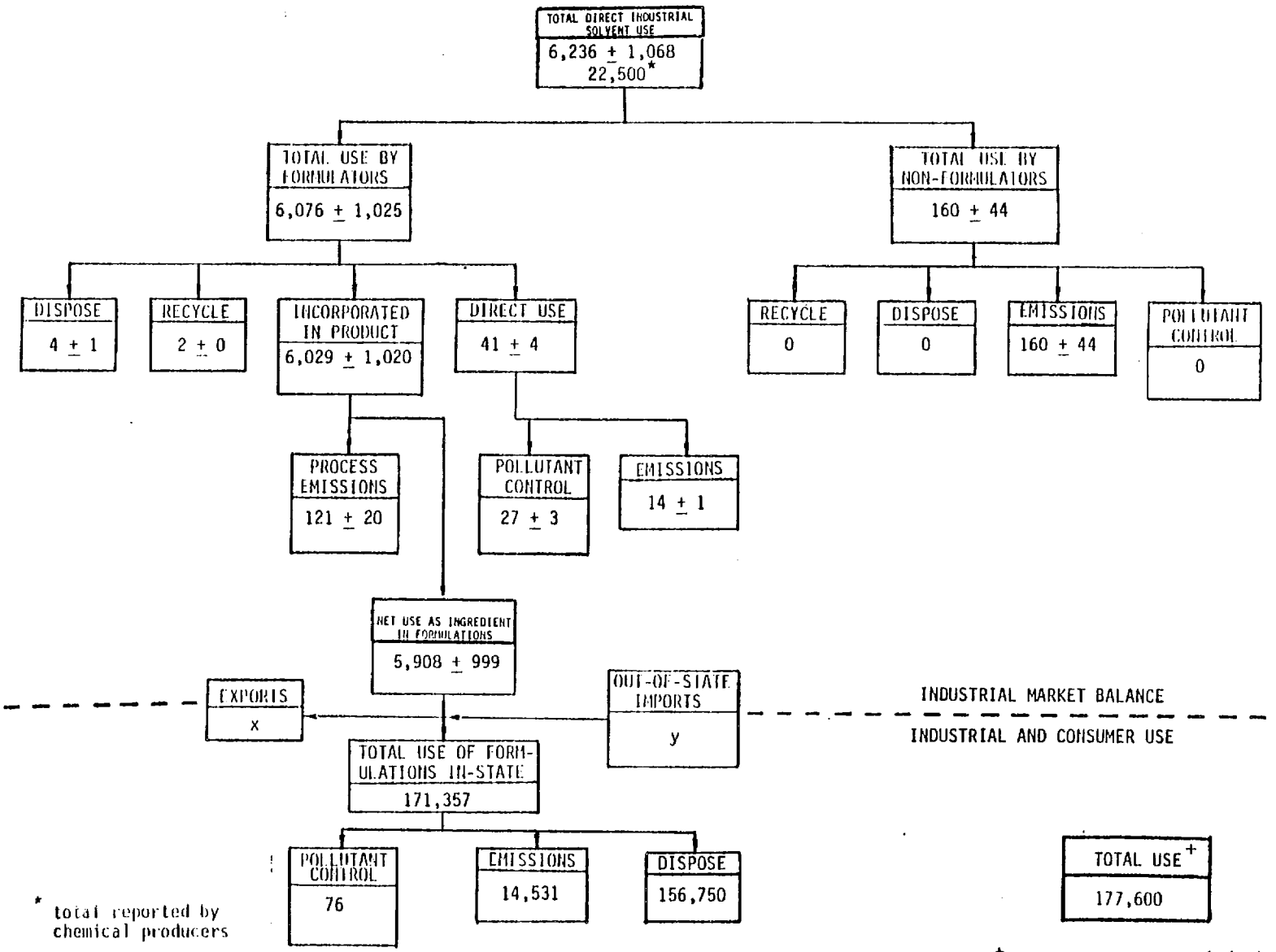

Figure 7.4-6. Market Balance Summary for Ethylene Glycol, 1980 (in 1000 lb).

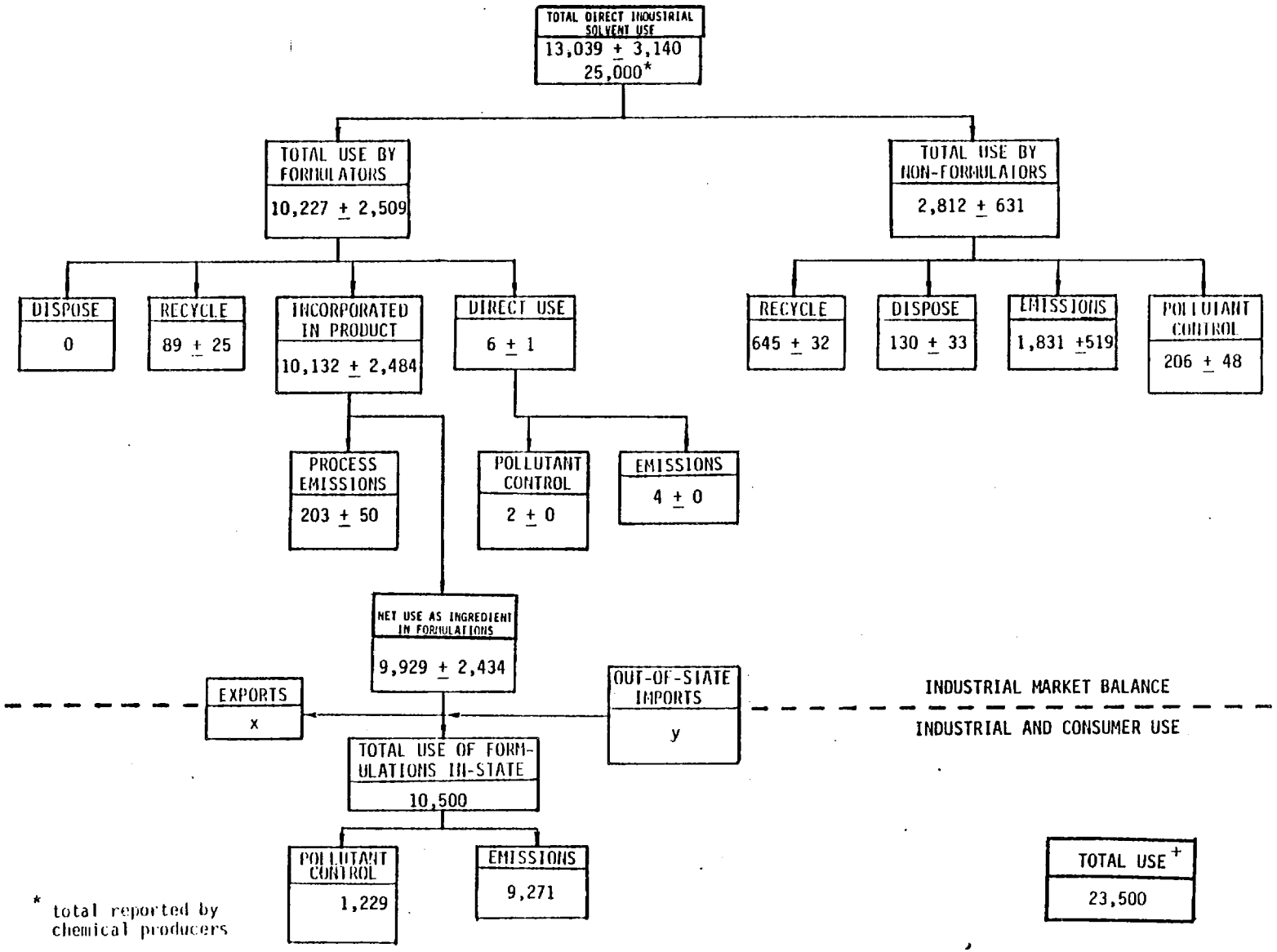

Figure 7.4-7. Market Balance Summary for Ethylene Glycol Monobutyl Ether, 1980 (in 1000 lb).

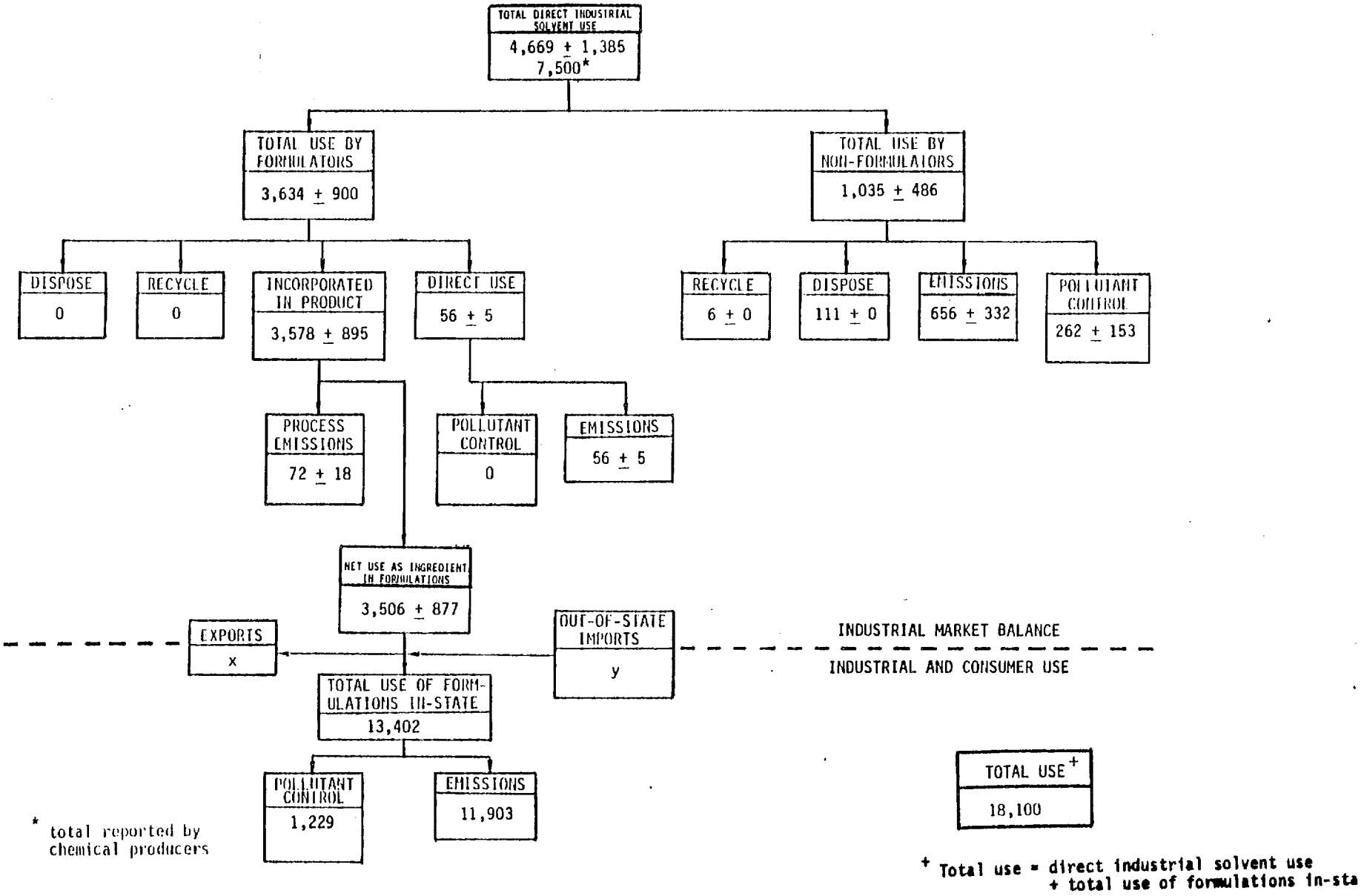

Figure 7.4-8. Market Balance Summary for Ethylene Glycol Monoethyl Ether, 1980 (in 1000 lb).

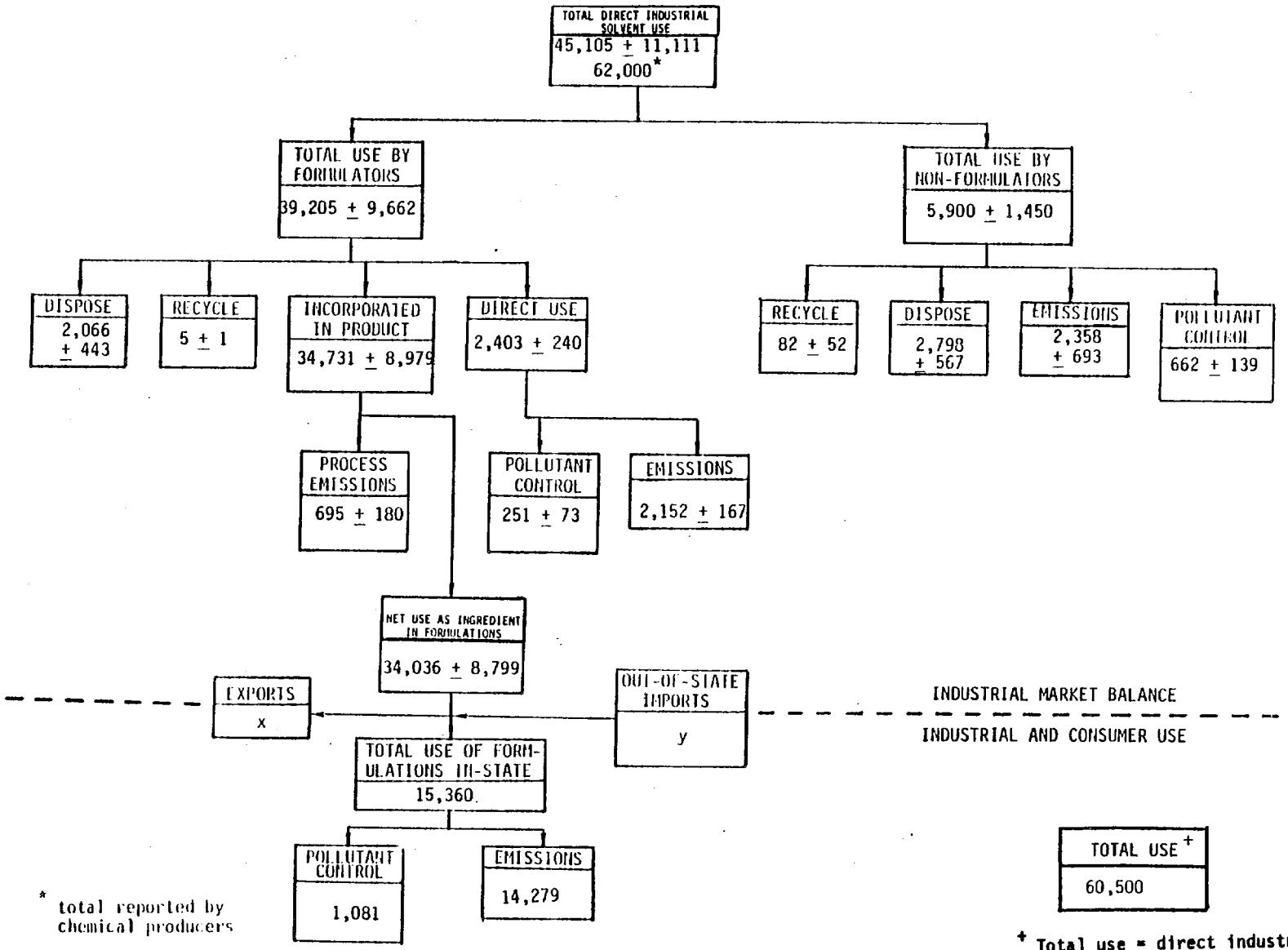

Figure 7.4-9. Market Balance Summary for Isopropanol, 1980 (in 1000 lb).

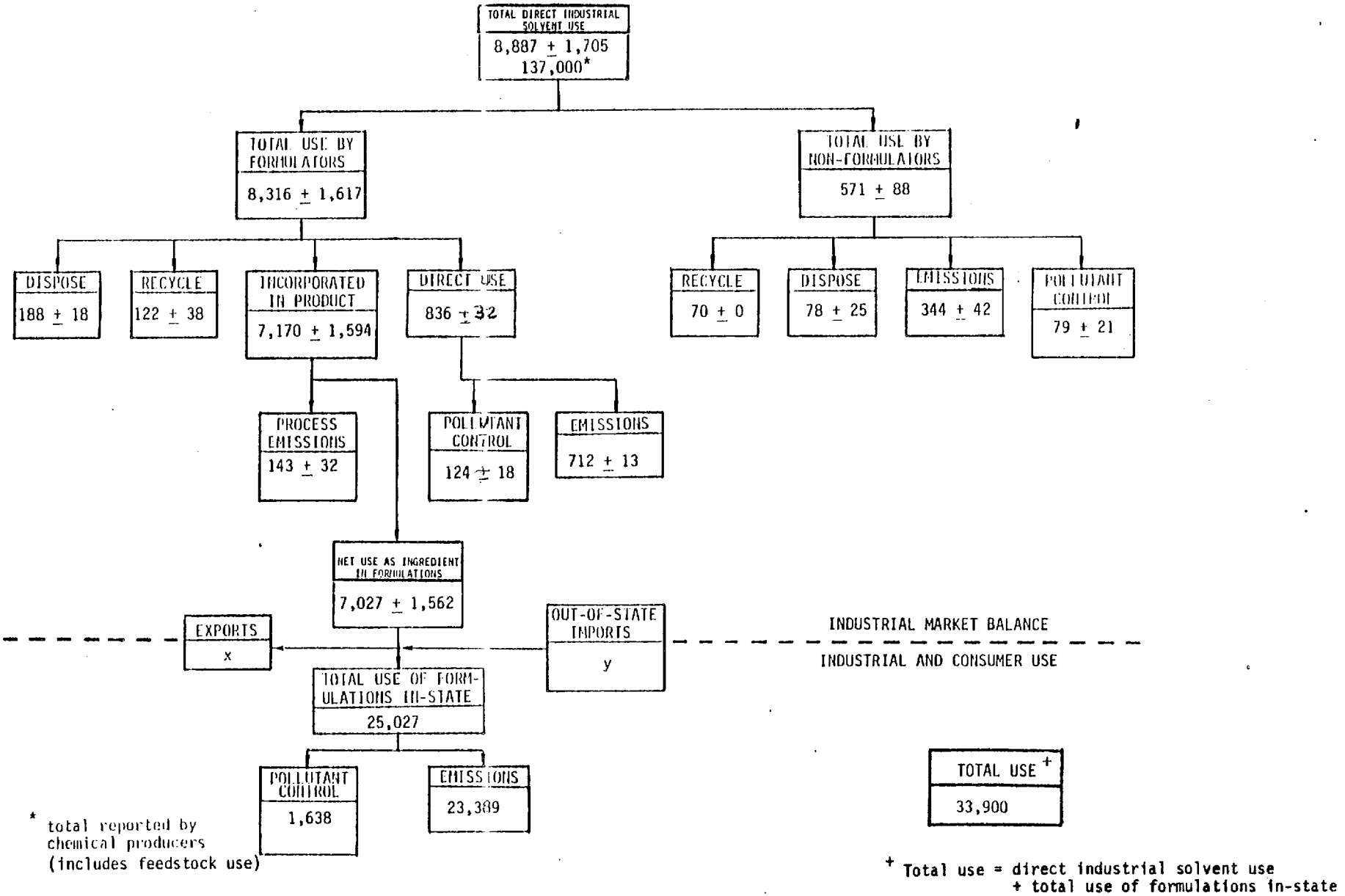

Figure 7.4-10. Market Balance Summary for Methanol, 1980 (in 1000 lb).

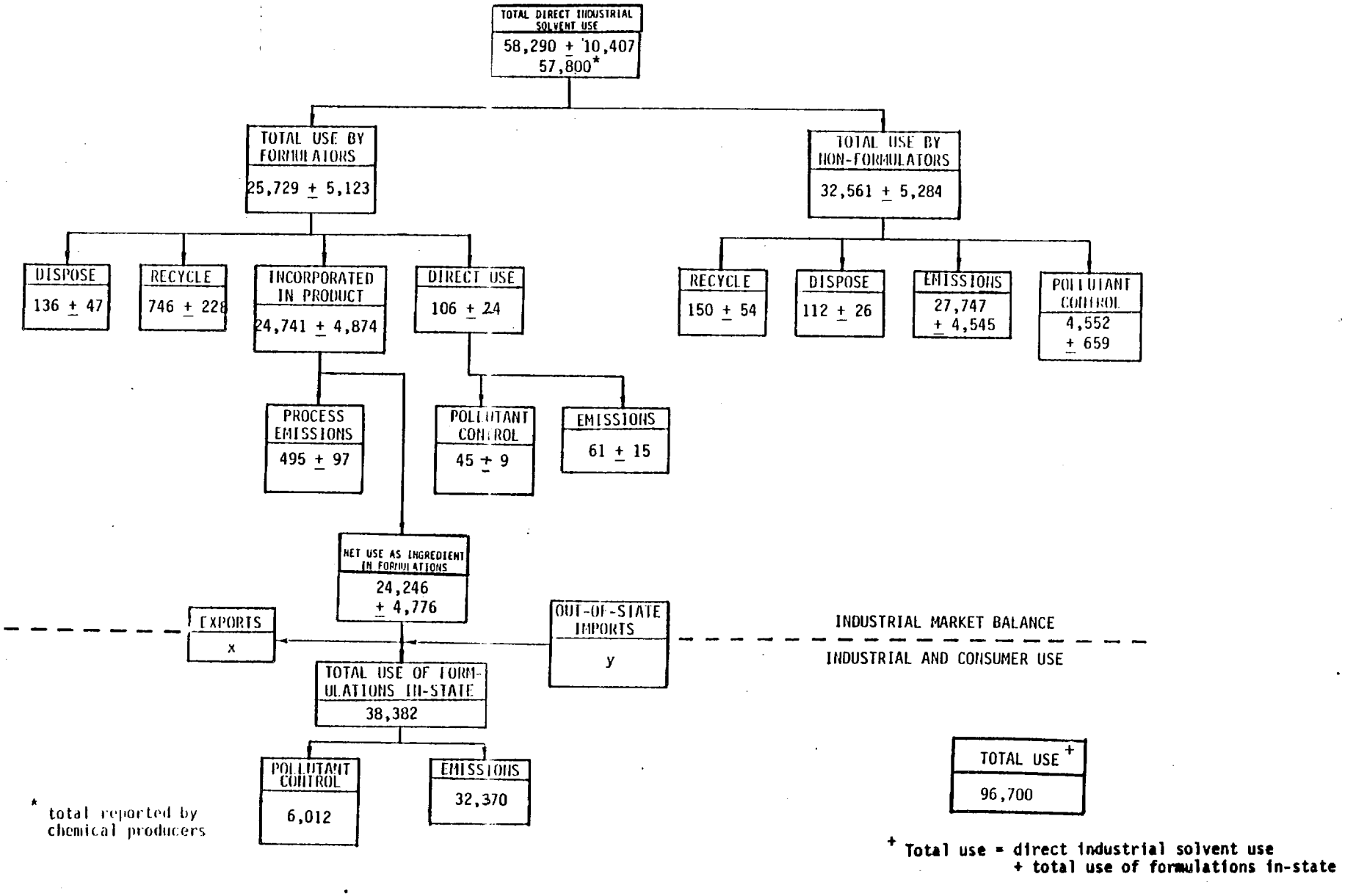

Figure 7.4-11. Market Balance Summary for Methyl Ethyl Ketone, 1980 (in 1000 lb).

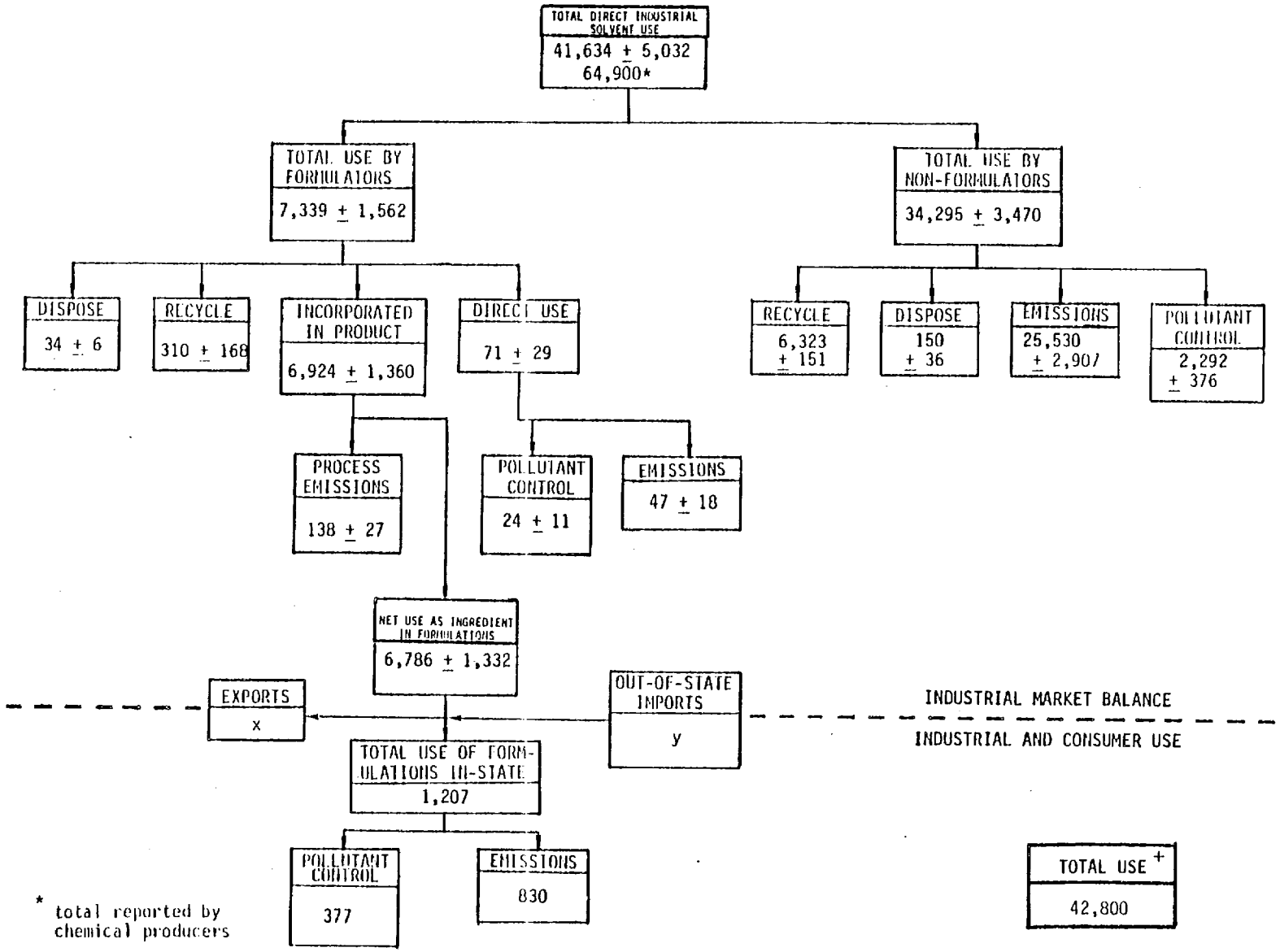

Figure 7.4-12. Market Balance Summary for Methyl Chloroform, 1980 (in 1000 lb).

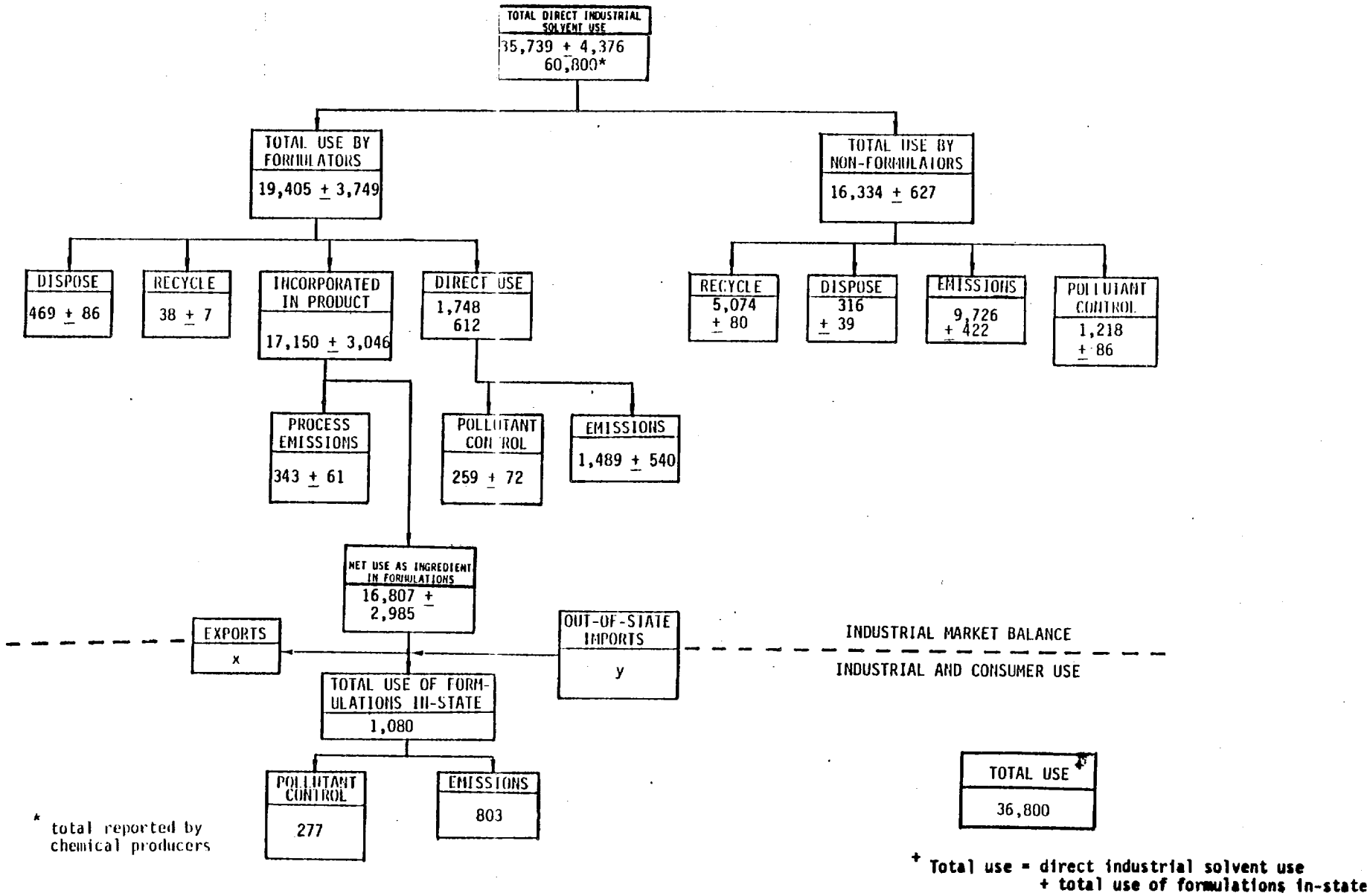

Figure 7.4-13. Market Balance Summary for Methylene Chloride, 1980 (in 1000 lb).

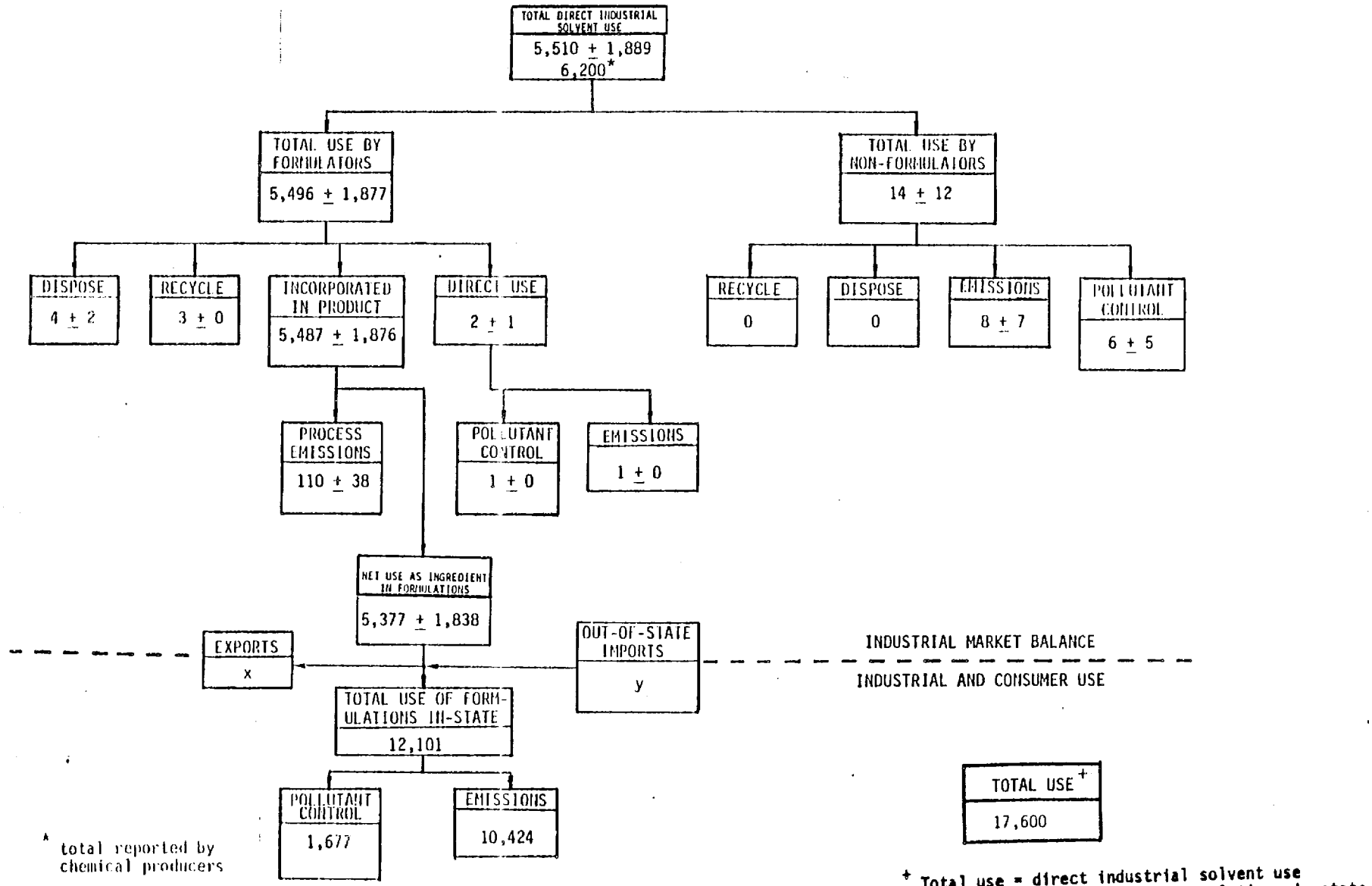

Figure 7.4-14. Market Balance Summary for Methyl Isobutyl Ketone, 1980 (in 1000 lb).

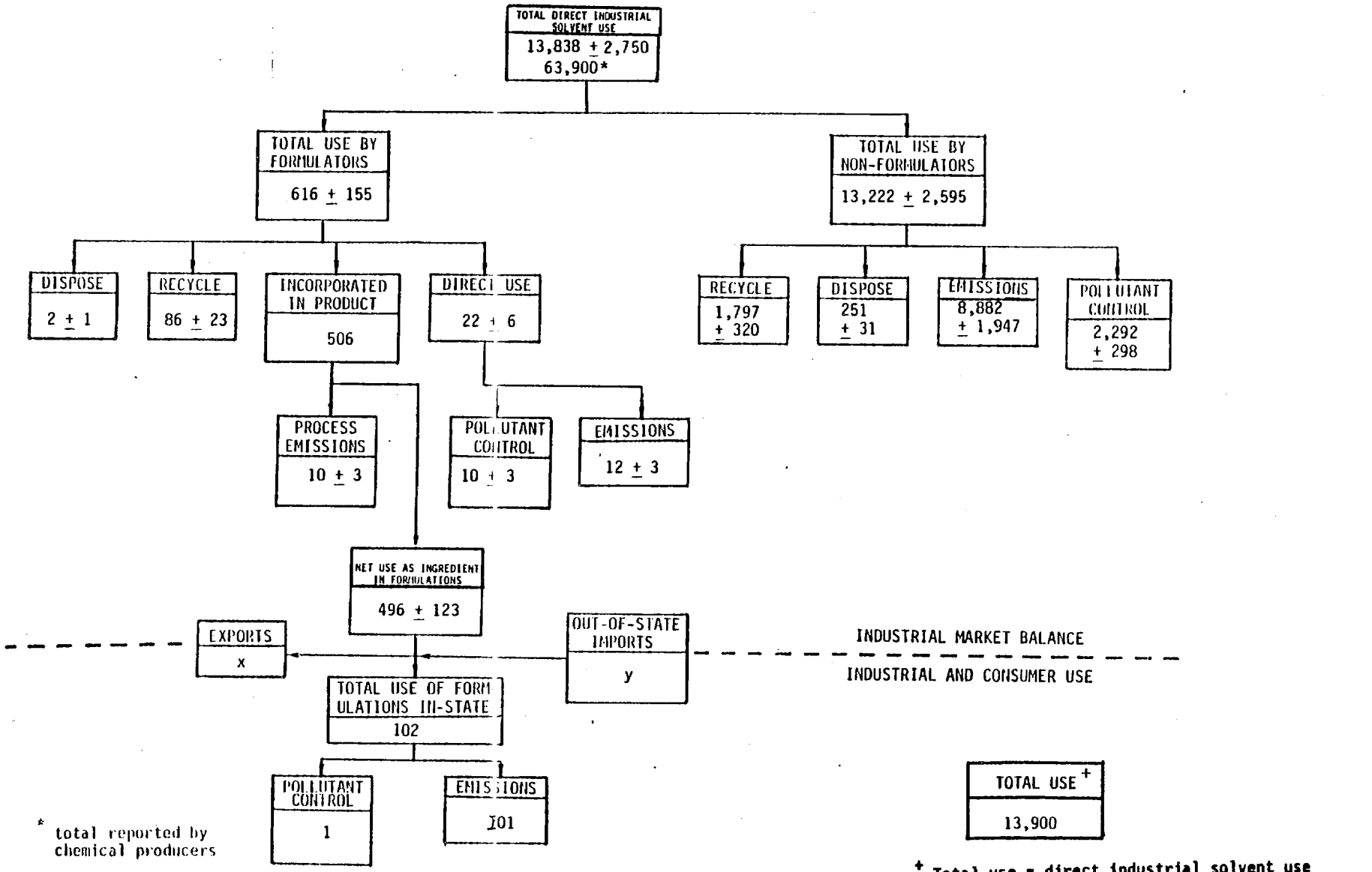

Figure 7.4-15. Market Balance Summary for Perchloroethylene, 1980 (in 1000 lb).

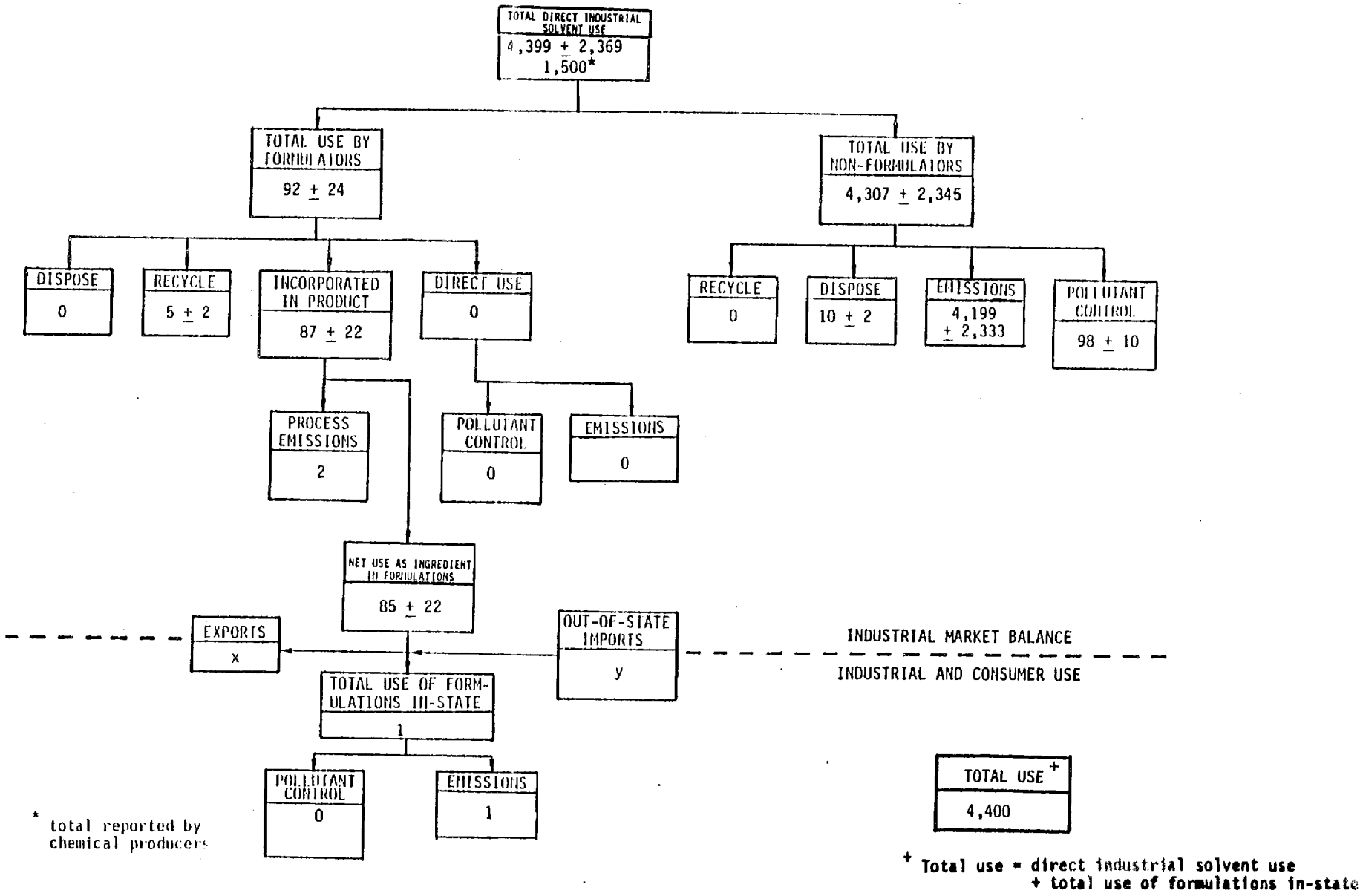

Figure 7.4-16. Market Balance Summary for n-Propanol, 1980 (in 1000 lb).

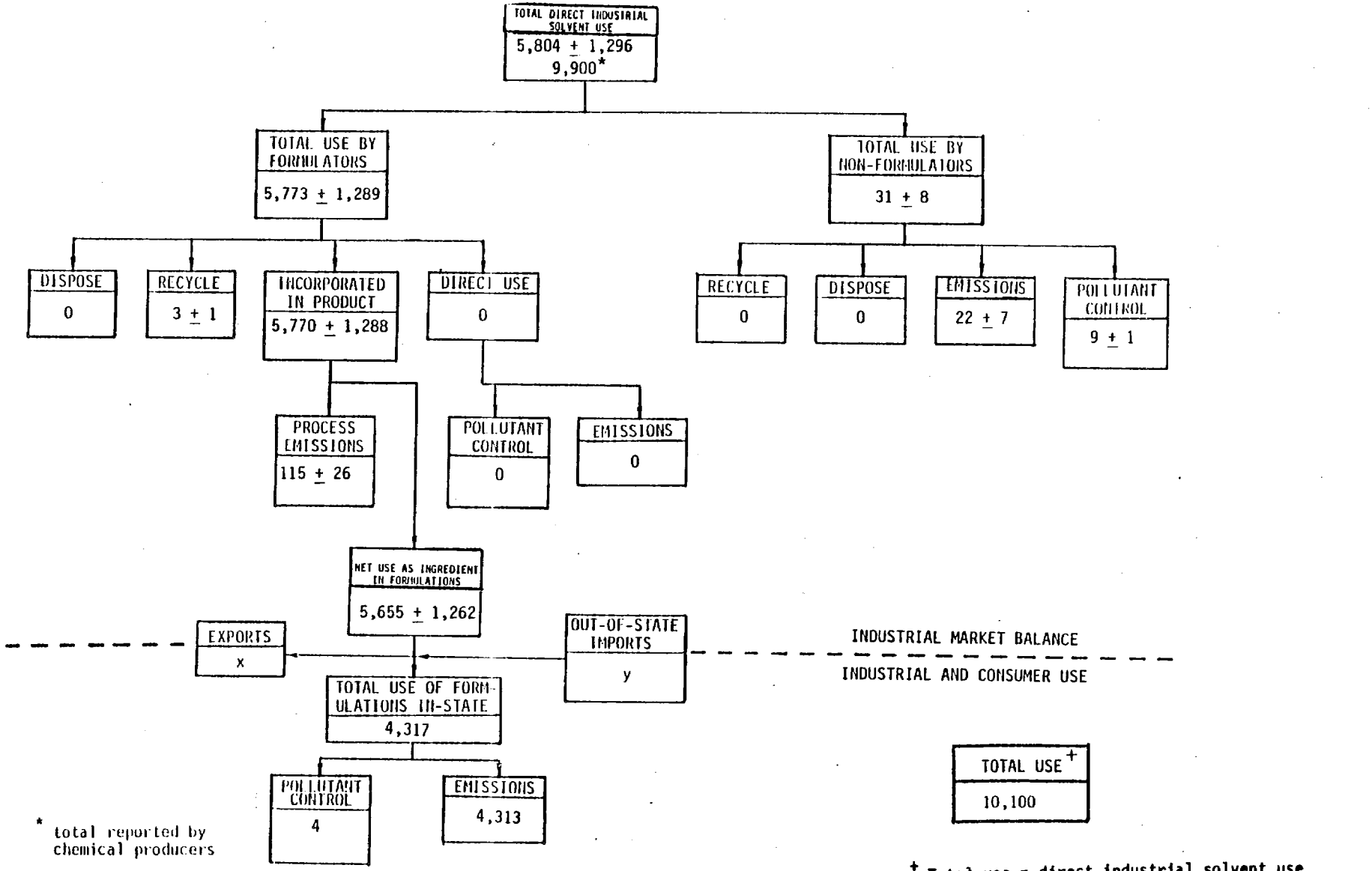

Figure 7.4-17. Market Balance Summary for Propylene Glycol, 1980 (in 1000 lb).

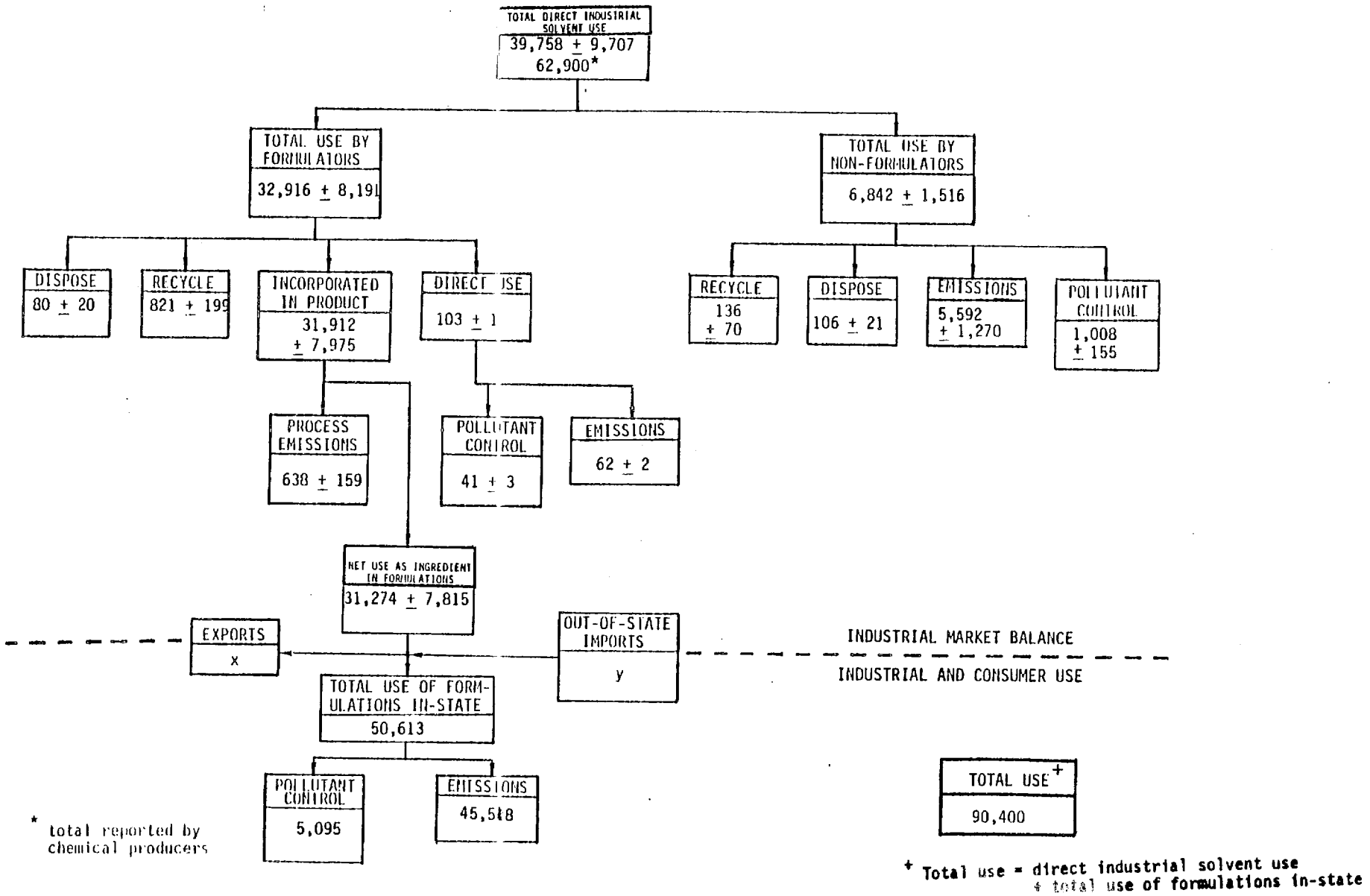

Figure 7.4-18. Market Balance Summary for Toluene, 1980 (in 1000 lb).

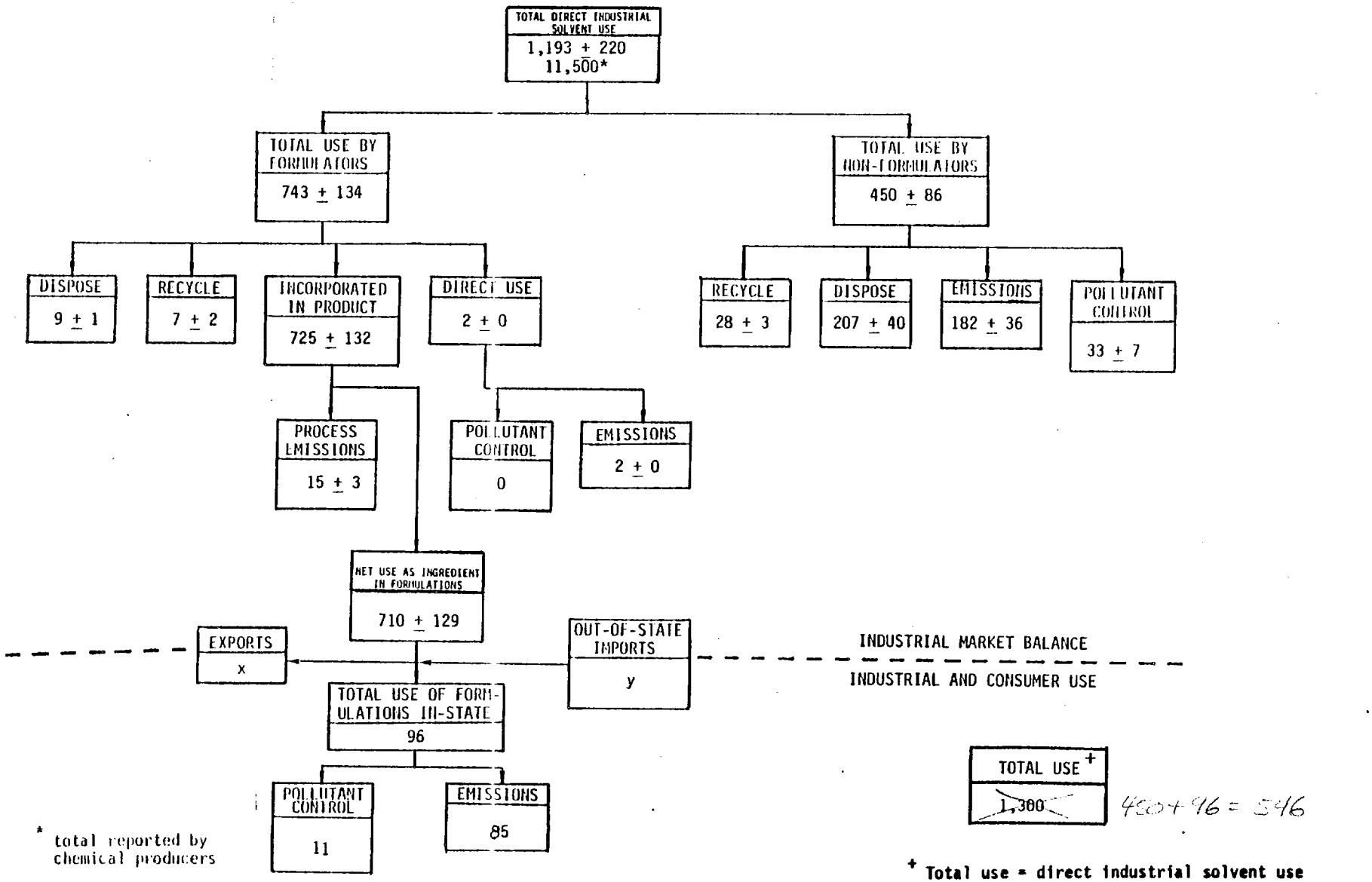

Figure 7.4-19. Market Balance Summary for Trichloroethylene, 1980 (in 1000 lb).

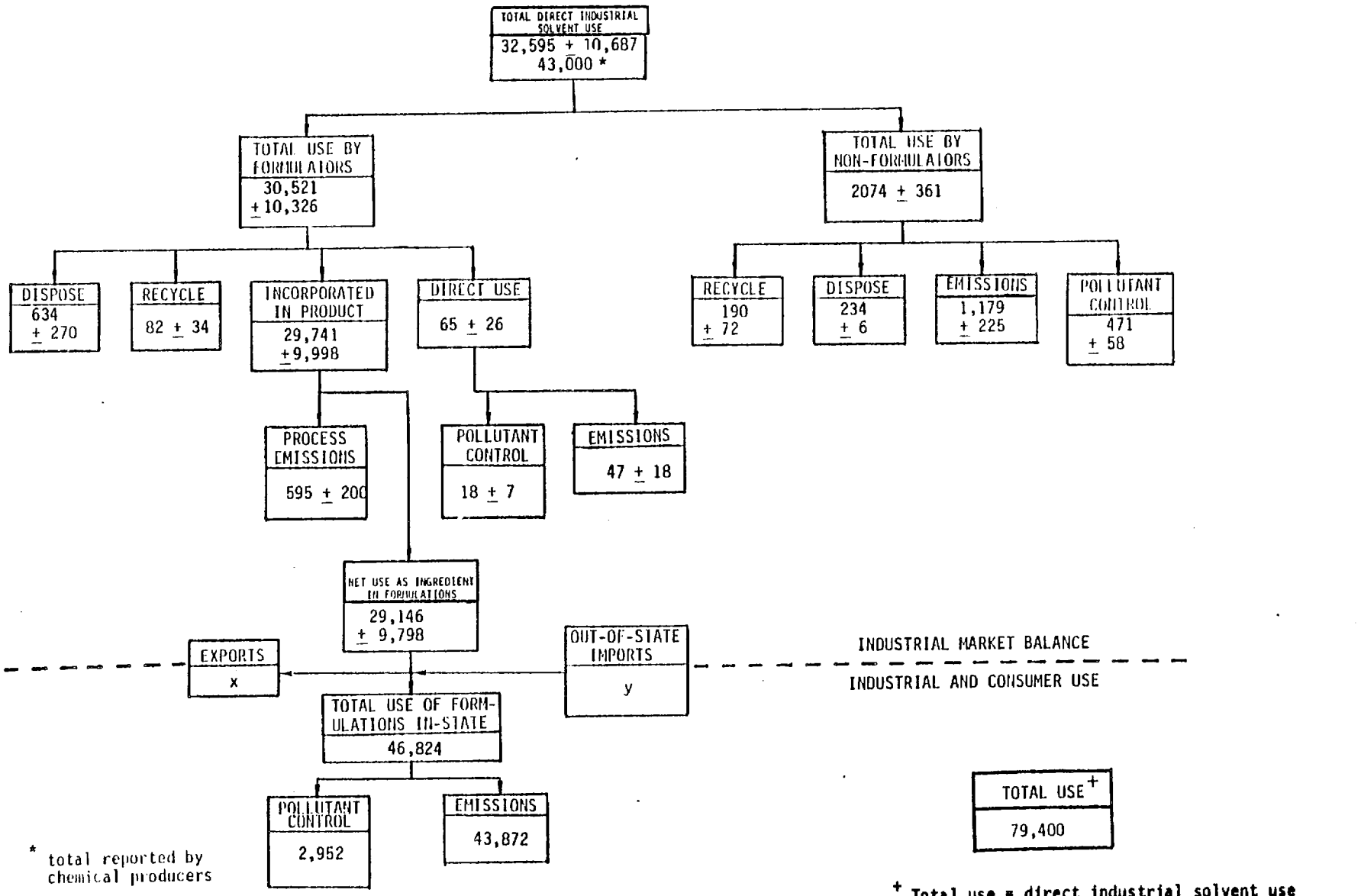

Figure 7.4-20. Market Balance Summary for Xylene, 1980 (in 1000 lb).

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8.0
GEOGRAPHICAL DISTRIBUTION OF TOTAL SOLVENT USE

One of the major objectives of this project was to ascertain the geographical distribution of solvent use in California. Since the San Francisco Bay Area, South Coast, San Joaquin Valley and San Diego County Air Basins account for over 95 percent of the state's total solvent use, our discussion will focus on those areas.

8.1 METHODS FOR APPORTIONMENT OF SOLVENT USE BY COUNTY

8.1.1 Direct Solvent Use

Direct solvent use consists of the direct application of individual solvents and solvent mixtures in such applications as chemical formulation, surface cleaning and paint thinning. Most of California's direct solvent use was accounted for in our direct industrial consumption and disposal survey, which was described in detail in Section 5.3.5. Using the stratified scale-up techniques discussed in that section, we estimated the direct solvent consumption for each SIC code in each county. County totals were then found by summing the values for all relevant SIC codes. Table 8.1-1 shows how this calculation was performed for Marin County. Results of these calculations are shown in the "Direct Industrial Use" column of Table 8.2-1.

Several direct solvent use categories were not covered by our survey. These include dry cleaning, degreasing in minor industrial categories and services, and use of thinners. Methods for estimating and apportioning their use to counties are described in the following sections.

8.1.1.1 Dry Cleaning Solvent Use

Dry cleaning solvent emission values for each county were obtained from the EDS. Emissions were converted into use rates by dividing by the weighted average emission factor ratio for SIC 7216. Using the method described in Section 5.4-1, we estimated the 95-percent confidence interval of this ratio to be 0.936 to 0.956. Confidence intervals for each county's dry cleaning solvent use were determined by dividing emission rates by the two

Table 8.1-1

EXAMPLE OF COUNTY DIRECT INDUSTRIAL SOLVENT USE CALCULATION: MARIN COUNTY (All values in lb/year)

SIC Code	Solvent Use From Survey[a] Low Estimate	High Estimate	Mean	High-Mean or Mean-Low
2751	3,276	6,006	4,641	1,365
3079	11,219	11,219	11,219	0
3429	1,155	2,310	1,733	578
Totals	15,650	19,535	17,593	1,943

[a] Low estimate based on stratified scale-up of survey results; high estimate = (no. firms in SIC code in county/no. firms reporting) x (reported use). See Section 5.3.5 for a complete description of the method.

Table 8.1-2

ACTIVITY CODES FOR WHICH EDS EMISSION VALUES WERE CONVERTED TO SOLVENT USE

Activity Code	Description	Activity Code	Description
131	Metal mining	320	Petroleum and gas marketing
133	Stone and clay mining	330	Miscellaneous services
140	Oil and gas extraction	333	Laundry and dry cleaners
210	Food and kindred[a]	334	Sanitary and water
245	Agricultural chemicals[a]	335	Health Services
270	Mineral products	336	Educational services
271	Glass and glass products	420	Rail transportation
281	Iron and steel production	440	Air transportation
283	Nonferrous metals	611	Building construction
300	Services and commerce	630	Government
310	Electric utilities	631	National security

[a] These activities were partially included in the direct industrial solvent consumption survey.

extremes of the weighted average emission factor ratio. For example, the EDS reports 5,248 tons of dry cleaning emissions in Los Angeles County. The low end of the 95-percent confidence interval for solvent use would therefore be 5248/0.956 tons, or 10,979,000 pounds. Similarly, the upper end of the interval would be 5248/0.956 tons or 11,214,000 pounds.

8.1.1.2 Minor Degreasing

Most of the use of surface cleaning solvents was accounted for by our survey. However, our survey did not cover point source industrial degreasing in the activities listed in Table 8.1-2, nor did it include area source degreasing use in "services and commerce." To obtain use rates from the EDS emission values in these categories, we divided emissions by the low and high ends of the 95-percent confidence interval for the mean emission factor ratio for all California industry. This interval is 0.830 to 0.847. For example, the EDS reported 644 tons (1,288,000 lb) of minor degreasing emissions in Alameda County. The low and high estimates for minor degreasing solvent use are 1288000/0.847 and 1288000/0.830, or 1,521,000 and 1,552,000 lb, respectively.

8.1.1.3 Miscellaneous Solvents

Our survey also did not cover solvent use (as identified by ARB Process Code 300) associated with the industrial activities whose ARB Activity Codes are listed in Table 8.1-2. EDS emission rates were converted to use rates by the same method as used for minor degreasing solvents.

8.1.1.4 Thinners

Finally, it was necessary to apportion the statewide use of 129,688,000 lb of paint and coating thinning solvents to the counties of interest. First, thinner use had to be apportioned among the coating categories listed in Table 6.1-5. It was assumed that thinner use would be proportional to coatings and use in each category. For example, wood flat stock coating solvents constitute 4.23 percent of all coating solvent use. Therefore

thinner use in this coating category would be (0.0423)(129,688,000) = 5,485,802 lb.

For each coating category, an appropriate basis with which to apportion solvent use to counties was chosen. Table 8.1-3 shows these bases. In the case of wood flat stock coating, the basis was the number of firms in SIC codes 2451, 2452 and 249. California has 508 firms in these industries. To see how this value was used, let us consider Orange County, which has 53 firms in the three base industries. That county's thinning solvent use would therefore be (53/508)(5,485,802) or 572,338 lb. Similar calculations were performed for each coating category for each county.

8.1.2 Indirect Solvent Use

Indirect solvent use consists of the application of solvent-bearing formulations such as paints and adhesives. Statewide solvent use in coatings, household products, automotive products, and industrial adhesives was determined by the methods described in Chapter 6.

Solvent use in industrial coatings was apportioned to counties in the following manner. As was explained in Section 6.1, we had already identified the SIC codes corresponding to each category of coatings use. For each coating category, we multiplied the statewide solvent use times each county's fraction of firms in the corresponding SIC codes. Use of solvents in architectural coatings, personal care products, and household products was apportioned according to population. Automotive product solvent use and use of solvents in traffic paints were apportioned according to annual vehicle miles traveled and county road mileage, respectively. Industrial adhesives use was assumed to be proportional to each county's ratio of firms in the industrial range of SIC codes to the corresponding state total.

The use of asphalt cutbacks and road oils in each county was apportioned by fraction of road mileage; statewide use in 1980 was estimated by the methods described in Section 4.2.3. Finally since our research did not include the use of aerosol propellants, we assumed that the emissions reported in the EDS for that category of emission source were equal to use.

Table 8.1-3

BASES FOR APPORTIONING THINNER USE AMONG COUNTIES

Coating Category	Total Thinner Use (1000 lb)	Apportionment Base	Value of Base
Wood Furniture and Fixtures	15,207	Firms in SIC 2511, 2512, 2517, 2521, 2541	1,006
Wood Flat Stock	5,487	Firms in SIC 2451, 2452, 249	508
Metal Furniture and Fixtures	6,848	Firms in SIC 2514, 2522, 254	433
Containers and Closures	12,449	Firms in SIC 341	87
Sheet, Strip and Coil	6,157	Firms in SIC 3479	213
Appliances	1,145	Firms in SIC 363	52
Automotive	2,769	Firms in SIC 3711	45
Trucks and Buses	1,659	Firms in SIC 3713	96
Railroad	52	Firms in SIC 374	6
Aircraft	1,561	Firms in SIC 372	370
Machinery and Equipment	5,312	Firms in SIC 352 through 358	3,019
Electrical Insulation	1,708	Firms in SIC 3612, 3613, 3621	175
Marine	3,181	Firms in SIC 373	340
Paper, Film and Foil	2,196	Firms in SIC 3479	213
Other Product Finishes	9,839	Firms in SIC 3479	213
Architectural	29,354	Population	23,667,902
Auto Refinishing	10,524	Firms in SIC 7535	414
Other Refinishing	1,405	Population	23,667,902
Traffic Paints	3,381	Road miles	2,878,290
Maintenance	5,292	Population	23,667,902
Other	4,163	Population	23,667,902
Total	129,688		

8.2 RESULTS

Tables 8.2-1 and 8.2-2 summarize our estimates of direct and indirect solvent use, respectively, in the major air basins. Direct use amounted to 871 $\pm$ 184 million lb in 1980. Only 10.5 percent of this total was derived from information presently in the EDS; 77 percent of the direct use was accounted for by our direct industrial consumption survey. The heaviest direct use of solvents occurs in Southern California, whose two major air basins account for almost 589 $\pm$ 135 million lb. The state's largest direct solvent-using counties are, in descending order, Los Angeles, San Mateo, Alameda, Orange and San Diego.

As seen in Table 8.2-2, total indirect solvent use in the major basins was 493 million lb in 1980, somewhat lower than direct solvent use. That the counties with the largest indirect solvent use were Los Angeles, San Diego, Orange, Santa Clara and Alameda is not surprising, since a large percentage of the indirect solvent use was apportioned by population. Coatings and household products combine to account for the largest fraction of indirect use. The almost 152 million lb of automotive product solvent use consists mainly of use of ethylene glycol in radiator antifreeze.

The total use of solvent in California in the major air basins in 1980, as shown in Table 8.2-3, was between 1.18 and 1.55 billion lb. The South Coast and San Diego air basins accounted for about two thirds of that amount. The counties having the heaviest total solvent use are Los Angeles, San Mateo, Alameda, San Diego and Orange.

Table 8.2-1

ESTIMATED DIRECT SOLVENT USE BY COUNTY AND MAJOR AIR BASIN, 1980
(All quantities in 1000 lb)

County and (Air Basin)	Direct Industrial Use Low	Direct Industrial Use High	Dry Cleaning Low	Dry Cleaning High	Minor Degreasing Low	Minor Degreasing High	Misc. Solvents Low	Misc. Solvents High	Thinner	Totals Low	Totals High
Los Angeles	263,243	495,923	10,979	11,214	9,884	10,087	8,607	8,783	52,284	344,997	578,290
Orange	29,815	48,341	2,236	2,284	1,773	1,810	0	0	12,431	46,256	64,866
Riverside	554	577	1,130	1,154	1,072	1,094	739	754	2,021	5,516	5,600
San Bernardino	2,955	5,141	964	985	1,851	1,889	288	294	5,372	11,431	13,682
(South Coast)	296,567	549,982	15,310	15,637	14,581	14,880	9,634	9,831	72,108	408,200	662,438
Alameda	55,767	93,967	2,364	2,415	1,521	1,552	26	27	6,569	66,247	104,529
Contra Costa	8,421	8,428	1,322	1,350	298	304	9	10	2,264	12,314	12,355
Marin	16	20	479	489	123	125	0	0	619	1,237	1,254
Napa	0	0	207	212	45	46	2	2	184	438	444
San Francisco	13,044	17,935	1,385	1,415	333	340	0	0	3,016	17,778	22,705
San Mateo	85,798	136,219	1,303	1,331	999	1,019	687	701	2,241	91,029	141,512
Santa Clara	10,253	13,939	2,843	2,904	1,370	1,398	7	7	6,781	21,254	25,029
Solano	17	20	452	462	130	133	0	0	599	1,197	1,213
Sonoma	18	18	546	558	172	176	0	0	774	1,511	1,526
(SF Bay Area)	173,334	270,546	10,902	11,135	4,989	5,092	732	747	23,048	213,005	310,567
(San Diego)	16,052	30,974	8,234	8,410	11,861	12,104	2,949	3,010	6,588	45,685	61,086
Fresno	164	176	981	1,002	4,418	4,508	0	0	1,827	7,390	7,514
Kern	583	988	586	598	279	284	0	0	960	2,408	2,831
Kings	0	0	59	60	333	340	0	0	156	548	556
Madera	0	0	46	47	246	251	0	0	185	477	483
Merced	1	2	48	49	609	622	0	0	314	972	987
San Joaquin	988	1,633	310	316	531	542	9	10	1,691	3,529	4,192
Stanislaus	11	11	205	209	1,296	1,323	0	0	1,061	2,573	2,604
Tulare	26	60	153	156	1,254	1,280	0	0	627	2,059	2,122
(San Joaquin Valley)	1,773	2,870	2,387	2,438	8,966	9,149	9	10	6,821	19,957	21,288
Total	487,726	854,372	36,833	37,620	40,397	41,224	13,325	13,598	108,656	686,846	1,055,379

Table 8.2-2

ESTIMATED INDIRECT SOLVENT USE BY COUNTY AND MAJOR AIR BASIN, 1980
(All quantities in 1000 lb)

County and (Air Basin)	Paints and Coatings				Automotive Products	Industrial Adhesives	Asphalt	Aerosol Propellants	Personal Care	Household Products	Total Indirect Use
	Industrial	Architectural	Traffic	Other							
Los Angeles	80,899	18,707.7	802	7,368	54,774	3,806	9,290	16,102	2,124	1,328	195,202
Orange	17,939	4,835.39	204	2,099	13,984	1,084	2,909	4,234	549	343	48,180
Riverside	1,445	1,659.15	250	547	5,601	282	2,946	1,430	188	118	14,466
San Bernardino	4,014	2,239.21	355	691	7,556	357	4,020	1,834	254	159	21,479
(South Coast)	104,297	27,441	1,611	10,704	81,915	5,529	19,165	23,600	3,116	1,948	279,327
Alameda	9,346	2,765.51	119	927	9,640	479	1,496	2,360	314	196	27,643
Contra Costa	2,215	1,642.18	102	466	4,226	241	1,425	1,364	186	117	11,984
Marin	440	556.836	45	233	2,291	120	558	480	63	40	4,827
Napa	0	248.183	32	94	663	49	401	206	28	18	1,738
San Francisco	3,723	1,698.70	34	651	3,892	336	298	1,414	193	121	12,351
San Mateo	2,431	1,469.42	75	551	4,715	285	999	1,270	167	104	12,068
Santa Clara	9,079	3,240.10	161	1,258	9,810	650	2,225	2,690	368	230	29,711
Solano	346	588.447	56	127	2,269	65	718	470	67	42	4,747
Sonoma	444	749.763	91	353	2,520	183	1,175	602	85	53	6,256
(S.F. Bay Area)	28,024	12,959	714	4,659	40,026	2,408	9,286	10,856	1,472	920	111,324
(San Diego)	28,024	4,658.10	309	1,412	13,144	729	3,355	3,865	529	331	56,355
Fresno	1,667	1,287.51	254	508	3,643	263	2,187	1,040	146	91	11,088
Kern	321	1,008.48	235	289	4,029	149	2,613	806	115	72	9,636
Kings	10	184.483	52	44	630	23	396	154	21	13	1,527
Madera	61	157.908	96	57	851	30	975	122	18	11	2,380
Merced	82	336.652	91	92	1,436	48	949	274	38	24	3,371
San Joaquin	975	869.004	109	282	2,700	145	1,349	686	99	62	7,275
Stanislaus	210	665.247	95	261	1,782	135	1,254	538	76	47	5,062
Tulare	225	614.804	198	218	1,841	113	2,311	496	70	44	6,130
(San Joaquin Valley)	3,551	5,124	1,130	1,750	16,912	906	12,034	4,116	582	364	46,470
Total	163,896	50,183	3,763	18,526	151,997	9,572	43,840	42,437	5,698	3,563	493,476

Table 8.2-3

TOTAL SOLVENT USE BY COUNTY AND MAJOR AIR BASIN, 1980
(All quantities in 1000 lb)

County and (Air Basin)	Direct		Indirect	Total	
	Low	High		Low	High
Los Angeles	344,997	578,290	195,202	540,199	773,492
Orange	46,256	64,866	48,180	94,437	113,047
Riverside	5,516	5,600	14,466	19,982	20,066
San Bernardino	11,431	13,682	21,479	32,910	35,160
(South Coast)	408,200	662,438	279,327	687,527	941,765
Alameda	66,247	104,529	27,643	93,890	132,172
Contra Costa	12,314	12,355	11,984	24,298	24,339
Marin	1,237	1,254	4,827	6,064	6,081
Napa	438	444	1,738	2,177	2,182
San Francisco	17,778	22,705	12,351	30,129	35,056
San Mateo	91,029	141,572	12,068	103,096	153,579
Santa Clara	21,254	25,029	29,711	50,964	54,739
Solano	1,197	1,213	4,747	5,945	5,960
Sonoma	1,511	1,526	6,256	7,767	7,782
(S.F. Bay Area)	213,005	310,567	111,324	324,329	421,891
(San Diego)	45,685	61,086	56,355	102,039	117,441
Fresno	7,390	7,514	11,088	18,478	18,602
Kern	2,408	2,831	9,636	12,044	12,467
Kings	548	556	1,527	2,075	2,083
Madera	477	483	2,380	2,856	2,862
Merced	972	987	3,371	4,344	4,358
San Joaquin	3,529	4,192	7,275	10,805	11,467
Stanislaus	2,573	2,604	5,062	7,635	7,666
Tulare	2,059	2,122	6,130	8,189	8,252
(San Joaquin Valley)	19,957	21,288	46,470	66,426	67,758
Total	686,846	1,055,379	493,476	1,180,321	1,548,854

9.0
GEOGRAPHICAL DISTRIBUTION OF SOLVENT EMISSIONS

9.1 METHODS FOR ESTIMATING EMISSIONS BY COUNTY

9.1.1 Emissions From Direct Solvent Use

Direct solvent emissions were assumed to result from direct industrial use, process losses during formulation of solvent-containing products such as paints and inks, dry cleaning, minor degreasing, miscellaneous solvent use and application of thinners. Emissions in each of these categories were calculated as follows.

9.1.1.1 Direct Industrial Solvent Use

Emissions from direct industrial use result from evaporation of solvents used in surface cleaning, extraction, and other direct uses. Using the results of our direct industrial solvent consumption and disposal survey, we calculated the net solvent use in each SIC code in each county. The net solvent use is defined as the total solvent purchased minus the amounts incorporated in liquid products, recycled and disposed. (Emissions from incorporation of solvents in liquid products are discussed in the next section.) Given the nature of the stratified scale-up method, these calculations resulted in lower and upper bounds for the estimate of net solvent use. The next step was to multiply net solvent use in each SIC code by the corresponding weighted emission factor ratio. Again, statistical analysis of these emission factor ratios resulted in lower and upper bounds. Given the uncertainty in both multiplicands, a "Monte Carlo" approach was used. That is, for each combination of SIC code and county, values for net use and emission factor were drawn randomly from uniform distributions of each variable. The two random values were then multiplied to obtain a value for the emissions. After 500 such calculations, the 95-percent confidence interval about the mean emission value was calculated. The lower and upper bounds of the emissions in all the SIC codes in each county were then summed.

9.1.1.2 Emissions From Liquid Product Formulation

Emissions were also assumed to occur during the formulation of liquid solvent-containing products such as paints, inks, solvent mixtures, and other chemicals. These emissions are associated with SIC codes 28 (Chemicals and Allied Products) and 29 (Petroleum and Coal Products). The first step was to apply the stratified scale-up method to the results of our direct industrial solvent consumption and disposal survey to estimate the amount of solvent incorporated in products in each of the pertinent SIC codes in each county. As was noted in Section 5.4.2, our review of the literature suggested the assumption of a two-percent process loss during product formulation. Emissions were therefore calculated by multiplying incorporated amounts by 0.02.

9.1.1.3 Dry Cleaning, Minor Degreasing, and Miscellaneous Solvent Use

Because our survey did not include dry cleaning establishments and minor degreasing sources (such as automobile repair shops), EDS values were used for emissions in these categories. Similarly, emissions in the miscellaneous solvent categories listed in Table 8.1-2 were taken directly from the EDS.

9.1.1.4 Thinners

In Section 8.1.1.4 we explained how thinner use was apportioned first among coating categories and then by county. Use values were converted to emissions by multiplying by the lower and upper bounds of the emission factor ratios for the SIC codes in each coating category. Table 9.1-1 shows how thinner emissions in 16 of the 21 coating categories were calculated for Stanislaus County. For example, this county has 3 of the state's 87 firms in SIC 341 (Metal Cans and Shipping Containers). Statewide thinner use in this coating category, as determined by the method presented in Section 8.1.1.4, is 12,449,480 lb. The low and high estimates for the weighted emission factor ratio are 0.559 and 0.593, respectively.*

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* For a 3-digit SIC code, the mean weighted emission factor ratio = $M_3 = (\Sigma n_i WEF_i)/\Sigma n_i$ where n_i = no. firms in EDS in 4-digit SIC code i and WEF_i = weighted emission factor ratio for SIC code i (see Table 5.4-1). The standard deviation for the 3-digit code = $S_3 = \sqrt{(\Sigma n_i \sigma_i^2)/\Sigma n_i}$ where σ_i is the standard deviation for the ith 4-digit SIC code. The confidence interval is then $CI = M_3 \pm t_{0.95}\, S_3/\sqrt{(\Sigma n_i)}$.

Table 9.1-1

EXAMPLE OF CALCULATION OF EMISSIONS DUE TO USE OF THINNERS IN MAJOR INDUSTRIAL CATEGORIES: STANISLAUS COUNTY

SIC Codes[a]	No. Firms in Calif.	Weighted Emission Factor Low	Weighted Emission Factor High	Total Thinner Use (1000 lb)	No. firms in County	Emissions (tons) Low	Emissions (tons) High
2511	425	0.9325	0.9875				
2512	235	0.123	0.877				
2517	17	1	1				
2521	81	0.9316	1				
2541	248	0.633	1				
WFF	1006			15206.67	0	0	0
2451	68	1	1		1		
2452	58	1	1				
249	382	1	1		2		
WFS	508			5487.608	3	16.2	16.2
2514	74	0.8266	1				
2522	33	0.9212	1				
254	326	0.8414	1				
MFF	433			6848.357	0	0	0
CC-341	87	0.559	0.593	12449.48	3	120.0	127.3
SSC-3479	213	0.8571	0.9189	6156.829	0	0	0
APP-363	52	0.582	0.824	1145.111	0	0	0
AUT-3711	45	0.8085	0.8955	2768.59	0	0	0
T&B-3713	96	1	1	1658.675	2	17.3	17.3
RR-374	6	1	1	52.54621	0	0	0
AIR-372	370	0.824	0.908	1560.523	0	0	0
352	204	0.507	1		6		
353	299	0.574	0.721				
354	949	0.472	0.995				
355	376	0.271	0.439		5		
356	506	0.444	0.851				
357	421	0.447	0.603				
358	264	1	1				
M&E	3019			5312.124	11	3.9	7.2

Table 9.1-1

EXAMPLE OF CALCULATION OF EMISSIONS DUE TO USE OF THINNERS IN MAJOR INDUSTRIAL CATEGORIES: STANISLAUS COUNTY (Continued)

SIC Codes[a]	No. Firms in Calif.	Weighted Emission Factor Low	Weighted Emission Factor High	Total Thinner Use (1000 lb)	No. firms in County	Emissions (tons) Low	Emissions (tons) High
3612	52	1	1				
3613	72	1	1				
3621	51	1	1				
EI	175			1707.752	0	0	0
MAR-373	340	0.921	1	3180.533	0	0	0
PFF-3479	213	0.857	0.919	2196.035	0	0	0
OPF-3479	213	0.857	0.919	9839.029	0	0	0
AR-7535	414	1	1	10523.62	0	0	0
Totals						157.4	168.0

[a] WFF = Wood furniture and fixtures; WFS = Wood flat stock; MFF = Metal furniture and fixtures; CC = Containers and closures; SSC = Sheet, strip and coil; APP = Appliances; AUT = Automotive; T&B = Trucks and buses; RR = Railroad; AIR = Aircraft; M&E = Machinery and equipment; EI = Electrical insulation; MAR = Marine; PFF = Paper, film and foil; OPF = Other product finishes; AR = Auto refinishing.

Therefore thinner emissions in this coating category in Stanislaus County are estimated to be:

Low = (0.559)(3/87)(12449480 lb)/2000 lb/ton = 120 tons

High = (0.593)(3/87)(12449480 lb)/2000 lb/ton = 127 tons

A similar calculation was performed for the coating category "Other Refinishing," in which case the range of weighted emission factor ratios was assumed to be the same as for statewide industry, i.e. 0.830 to 0.847. Since Stanislaus County's thinner use in this category was estimated to be 15,805 lb, emissions were calculated to be (0.830)(15805) to (0.847)(15805) lb or 6.6 to 6.7 tons. For the remaining four coatings categories (Architectural, Traffic Paints, Maintenance and "Other"), thinner emissions were assumed to be equal to thinner use. Continuing the Stanislaus County example, emissions in these four categories are 330,110 lb, 47,051 lb, 59,512 lb and 46,813 lb, respectively, for a total of 242 tons. The grand total of thinner emissions in the 21 coatings categories is 406 to 416 tons.

9.1.2 Emissions From Indirect Solvent Use

Indirect emissions result from the use of surface coatings, household and automotive products, asphalt cutbacks, aerosol propellants, and industrial adhesives. All of the solvents used in architectural coatings and road paints were assumed to be emitted to the atmosphere. Industrial coatings emissions were estimated by the same method as was used for industrial thinners.

All the solvents in automotive products, except for ethylene glycol in radiator antifreeze, were assumed to be emitted to the atmosphere. Although the case may be made that the ethylene glycol sooner or later finds its way into the atmosphere, we have made the conservative assumption that only five percent of this radiator antifreeze solvent is emitted. Asphalt and aerosol propellant emissions were taken directly from the EDS. Industrial adhesives emissions were estimated by multiplying the use in this category by the lower and upper bounds for the statewide average weighted emission factor ratio, i.e. 0.830 and 0.847.

9.2 RESULTS

Table 9.2-1 shows our estimates of emissions from direct use of organic solvents in the four major air basins. Total emissions are estimated to be 125,300 ± 14,100 tons. The largest fraction of direct use emissions results from use of thinners, which represent about 39 percent of the total. Emissions from direct industrial use, as determined from our survey, account for another 25 percent. Direct industrial use emissions are most important in Los Angeles, Orange, and Santa Clara Counties; in other counties, these emissions represent no more than about 15 percent of total direct emissions. Figure 9.2-1 shows the distribution of direct use emissions by air basin.

Total emissions resulting from indirect solvent use, as seen in Table 9.2-2, are estimated to be 151,100 ± 4,300 tons per year. Almost two-thirds of these emissions result from the application of paints and other surface coatings. Other important indirect use emissions sources in the four major air basins are the use of aerosol propellants, asphalt cutbacks, and automotive products. Figure 9.2-2 shows the distribution of indirect use emission by air basin. Los Angeles County accounts for almost half of the emissions from surface coatings. Other counties with relatively high indirect use emissions are Orange, Santa Clara, Alameda and San Bernardino.

As seen in Table 9.2-3, our estimate of total solvent emissions in the four major air basins in 1980 is 276,400 ± 18,400 tons. Emissions from direct and indirect solvent use are responsible for 45 and 55 percent of the total, respectively.

Our emission estimate may, for the most part, be considered as an independent check on the EDS. Exceptions are those emission categories for which values were obtained directly from the EDS: dry cleaning, minor degreasing, miscellaneous solvents in industries not included in our survey, asphalt cutbacks and aerosol propellants. These categories represent about 27 percent of our total solvent emission estimate for the four major air basins. With one exception, an appropriate EDS source category (or group of categories) can be identified for each of the emission categories shown in Tables 9.2-1 and 9.2-2. The sole exception is process emissions in SIC codes 28 and 29. The

Table 9.2-1

ESTIMATED EMISSIONS FROM DIRECT SOLVENT USE IN MAJOR AIR BASINS IN 1980[a]

(Emissions in tons)

County and (Air Basin)	Direct Industrial Use Low	Direct Industrial Use High	Process Losses in SIC 28 & 29 Low	Process Losses in SIC 28 & 29 High	Dry Cleaning	Minor Degreasing	Misc. Solvents	Thinners Low	Thinners High	Totals Low	Totals High
Los Angeles	10,497	22,236	1,849	3,670	5,248	4,186	3,645	21,836	24,413	47,262	63,399
Orange	5,634	12,487	137	200	1,069	751	0	5,370	5,857	12,961	20,364
Riverside	197	240	1	1	540	454	313	1,003	1,049	2,508	2,597
San Bernardino	37	64	27	47	461	784	122	2,530	2,626	3,961	4,104
(South Coast)	16,365	35,027	2,013	3,918	7,318	6,175	4,080	30,741	33,945	66,692	90,464
Alameda	323	1,114	531	877	1,130	644	11	2,755	2,964	5,394	6,740
Contra Costa	82	195	63	63	632	126	4	990	1,029	1,897	2,049
Marin	1	5	0	0	229	52	0	303	307	586	592
Napa	0	0	0	0	99	19	1	92	92	211	211
San Francisco	86	164	128	174	662	141	0	1,250	1,361	2,267	2,502
San Mateo	58	522	811	1,266	623	423	291	959	1,028	3,165	4,154
Santa Clara	1,043	1,523	68	93	1,359	580	3	2,921	3,126	5,974	6,685
Solano	4	6	0	0	216	55	0	298	301	573	578
Sonoma	9	9	0	0	261	73	0	358	377	701	720
(San Francisco Bay Area)	1,606	3,537	1,601	2,474	5,211	2,113	310	9,927	10,585	20,769	24,231
(San Diego)	2,111	2,645	101	127	3,936	5,023	1,249	3,192	3,366	15,612	16,346

Table 9.2-1

ESTIMATED EMISSIONS FROM DIRECT SOLVENT USE IN MAJOR AIR BASINS IN 1980
(Emissions in tons)
(Continued)

County and (Air Basin)	Direct Industrial Use Low	Direct Industrial Use High	Process Losses in SIC 28 & 29 Low	Process Losses in SIC 28 & 29 High	Dry Cleaning	Minor Degreasing	Misc. Solvents	Thinners Low	Thinners High	Totals Low	Totals High
Fresno	10	15	1	1	469	1,871	0	847	901	3,198	3,257
Kern	107	192	2	2	280	118	0	464	474	971	1,067
Kings	0	0	0	0	28	141	0	77	78	246	247
Madera	0	0	0	0	22	104	0	91	92	217	218
Merced	0	0	0	0	23	258	0	152	156	433	437
San Joaquin	7	20	10	11	148	225	4	687	737	1,081	1,144
Stanislaus	<1	1	<1	<1	98	549	0	406	416	1,053	1,064
Tulare	2	3	<1	<1	73	531	0	305	311	911	918
(San Joaquin Valley)	127	230	13	14	1,141	3,797	4	3,028	3,166	8,110	8,359
Total, Major Air Basins	20,210	41,440	3,728	6,533	17,606	17,108	5,643	46,888	51,063	111,183	139,393

[a] Errors in basin subtotals, county totals and column totals are due to rounding.

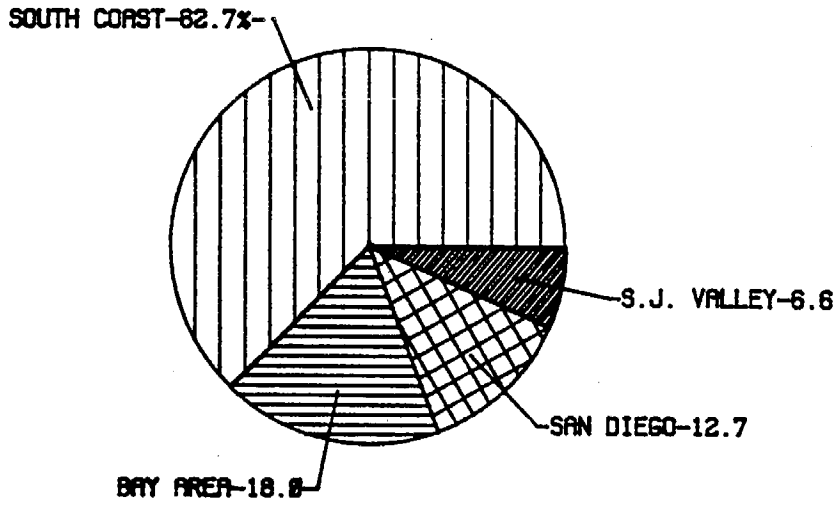

Figure 9.2-1. Distribution of Direct Solvent Use Emissions by Major Air Basin.

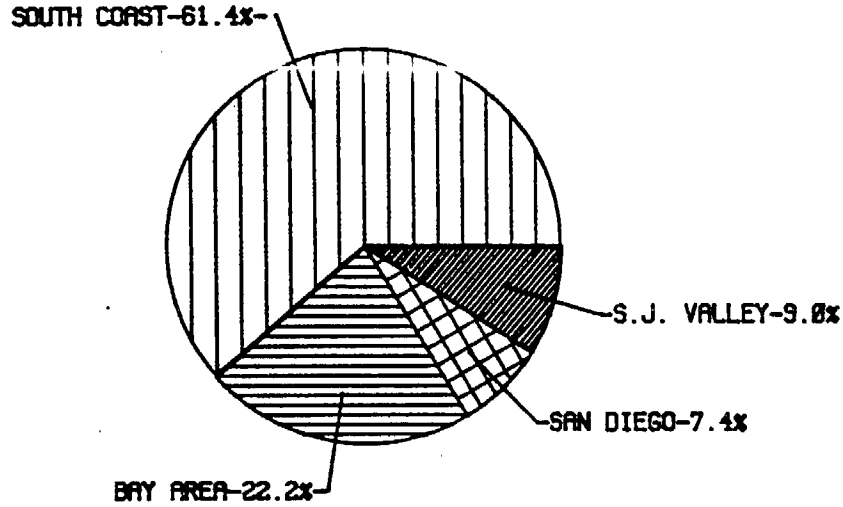

Figure 9.2-2. Distribution of Indirect Solvent Use Emissions by Major Air Basin.

Table 9.2-2

ESTIMATED EMISSIONS FROM INDIRECT SOLVENT USE BY COUNTY AND MAJOR AIR BASIN, 1980[a]
(Emissions in tons)

County and (Air Basin)	Paints and Coatings					Automotive Products	Industrial Adhesives		Asphalt	Aerosol Propellants	Personal Care	Household Products	Total Indirect Use	
	Industrial		Architectural	Traffic	Other									
	Low	High					Low	High					Low	High
Los Angeles	32,969	38,167	9,354	401	1,326	3,971	1,579	1,612	4,237	8,051	1,062	664	63,615	68,845
Orange	7,971	8,953	2,418	102	343	1,014	450	459	1,114	2,117	275	172	15,975	16,966
Riverside	952	1,044	830	125	118	406	117	119	376	715	94	59	3,791	3,885
San Bernardino	2,268	2,462	1,120	178	330	548	148	151	484	917	127	79	6,199	6,396
(South Coast)	44,160	50,625	13,721	806	2,117	5,939	2,295	2,342	6,211	11,800	1,558	974	89,580	96,092
Alameda	3,919	4,341	1,383	60	196	699	199	203	437	1,180	157	98	8,327	8,753
Contra Costa	1,010	1,087	821	51	116	306	100	102	345	682	93	58	3,583	3,662
Marin	271	278	278	23	39	166	50	51	185	240	32	20	1,304	1,312
Napa	27	27	124	16	18	48	20	21	115	103	14	9	494	495
San Francisco	1,535	1,759	849	17	120	282	139	142	137	707	96	60	3,944	4,171
San Mateo	1,059	1,198	735	38	104	342	118	121	277	635	83	52	3,443	3,584
Santa Clara	3,963	4,377	1,620	81	230	711	270	275	551	1,345	184	115	9,069	9,488
Solano	237	243	294	28	42	165	27	28	155	235	33	21	1,237	1,244
Sonoma	249	288	375	46	53	183	76	78	203	301	43	27	1,555	1,595
(San Francisco Bay Area)	12,271	13,598	6,480	358	919	2,902	999	1,020	2,405	5,428	736	460	32,957	34,305
(San Diego)	3,625	3,977	2,329	155	330	953	303	309	891	1,932	264	165	10,947	11,306
Fresno	846	956	644	127	91	264	109	111	595	520	73	46	3,315	3,427
Kern	243	264	504	118	72	292	62	63	574	403	57	36	2,360	2,382
Kings	23	26	92	26	13	46	10	10	26	77	10	7	330	333
Madera	45	48	79	48	11	62	12	13	238	61	9	6	572	575
Merced	69	77	168	46	24	104	20	20	132	137	19	12	731	739
San Joaquin	835	935	435	55	62	196	60	61	954	343	49	31	3,019	3,120
Stanislaus	391	412	333	48	47	129	56	57	166	269	38	24	1,499	1,522
Tulare	166	178	307	99	44	133	47	48	470	248	35	22	1,571	1,583
(San Joaquin Valley)	2,618	2,896	2,562	565	363	1,226	376	384	3,155	2,058	291	182	13,396	13,682
Total	62,673	71,096	25,091	1,883	3,730	11,020	3,972	4,054	12,662	21,218	2,849	1,781	146,880	155,384

[a] Errors in basin subtotals, county totals and column totals are due to rounding.

Table 9.2-3

ESTIMATED TOTAL SOLVENT EMISSIONS BY COUNTY AND MAJOR AIR BASIN, 1980[a]
(Emissions in tons)

County and (Air Basin)	Emissions From Direct Use Low	Direct Use High	Indirect Use Low	Indirect Use High	Total Emissions Low	Total Emissions High
Los Angeles	47,262	63,399	63,615	68,845	110,876	132,244
Orange	12,961	20,364	15,975	16,966	28,936	37,330
Riverside	2,508	2,597	3,791	3,885	6,300	6,482
San Bernardino	3,961	4,104	6,199	6,396	10,160	10,500
(South Coast)	66,692	90,464	89,580	96,092	156,272	186,556
Alameda	5,394	6,740	8,327	8,753	13,721	15,493
Contra Costa	1,897	2,049	3,583	3,662	5,480	5,711
Marin	586	592	1,304	1,312	1,889	1,904
Napa	211	211	494	495	705	705
San Francisco	2,267	2,502	3,944	4,171	6,211	6,673
San Mateo	3,165	4,154	3,443	3,584	6,609	7,738
Santa Clara	5,974	6,685	9,069	9,488	15,044	16,173
Solano	573	578	1,237	1,244	1,810	1,822
Sonoma	701	720	1,555	1,595	2,256	2,316
(San Francisco Bay Area)	20,769	24,231	32,957	34,305	53,725	58,536
(San Diego)	15,612	16,346	10,947	11,306	26,559	27,652
Fresno	3,198	3,257	3,315	3,427	6,513	6,684
Kern	971	1,067	2,360	2,382	3,332	3,449
Kings	246	247	330	333	575	580
Madera	217	218	572	575	789	793
Merced	433	437	731	739	1,164	1,176
San Joaquin	1,081	1,144	3,019	3,120	4,100	4,264
Stanislaus	1,053	1,064	1,499	1,522	2,553	2,586
Tulare	911	918	1,571	1,583	2,482	2,502
(San Joaquin Valley)	8,110	8,353	13,396	13,682	21,507	22,034
Total, Major Air Basins	111,183	139,393	146,880	155,384	258,063	294,777

[a] Errors in basin subtotals, county totals and column totals are due to rounding.

corresponding process codes in the EDS, 500 (Industrial Processes) and 510 (Chemical Processes), include emissions of both solvents and non-solvent materials, while our estimates pertain only to solvents. In comparing our emissions estimates with those in the EDS, we have therefore deleted the 5,131 ± 1,403 tons corresponding to losses of solvent ingredients during liquid product manufacturing.

According to the EDS, emissions in the four major air basins corresponding to the emission categories addressed in this study total 276,954 tons per year. This falls within our adjusted range of 254,300 to 288,200 tons/year. As seen in Figure 9.2-3, however, there are some discrepancies between our estimates and the EDS for individual air basins. For the South Coast Air Basin, our esimate is from 9 to 30 percent higher than the EDS value, depending on which end of our range is used for comparison. This implies that significant solvent emissions may not be accounted for in this portion of the EDS. For the other three air basins, our estimates are lower than those reported in the EDS. The largest discrepancy corresponds to the San Diego Air Basin, for which our values are 26 to 29 percent lower than those in the EDS.

9.3 UNCERTAINTIES IN THE EMISSION ESTIMATES

In the market balance summaries for individual solvent species (Section 7.4), and in the estimates of solvent use and emissions in the four major air basins, uncertainty estimates have been presented, wherever possible, as ± values. It is important to recognize however, that all the solvent use and emissions estimates presented in this report are subject to uncertainty, whether it can be quantified or not. Unfortunately, the discrepancy between reported and "actual" values is virtually impossible to know. We believe, however, that the results reported here are at least as reasonable as could be obtained by any other study of this scope. The following discussion will address particular areas of uncertainty.

9.3.1 Uncertainties in Apportionment

California solvent use in several categories, such as paints and coatings, was estimated by apportioning national use to the State on various

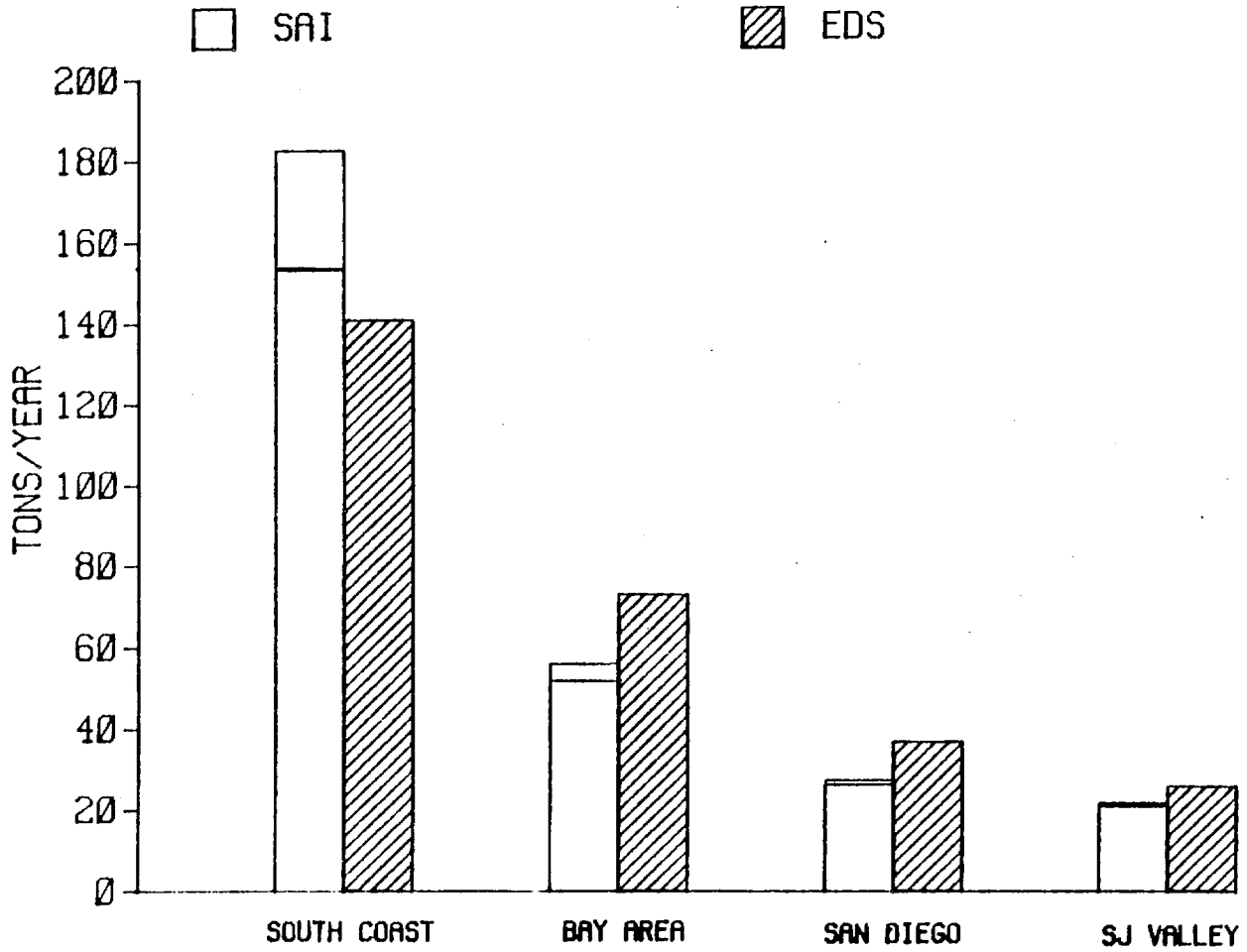

Figure 9.2-3. Comparison of SAI and EDS Estimates of Organic Solvent Emissions in the Four Major California Air Basins. (Horizontal Lines in the SAI Bars Indicate Lower Bounds of Estimates.)

bases, including population and worker hours. Uncertainty in the use estimates may result from uncertainties in (1) the national solvent use values, (2) the values for the apportionment bases, and (3) the apportionment method itself.

As was discussed in Chapter 6, national use rates for various solvent-containing products, such as paints and coating, deodorants, and automotive products, are based upon market research. The uncertainty in these rates is not always reported. The solvent content of the products may vary over a considerable range. It would probably not be too conservative to estimate the total uncertainty as ± 50 percent in many cases. In contrast, the uncertainty in the values for the apportionment bases (e.g. population, registered automobiles, etc.) is fairly small. Finally, the apportionment methods, being based upon the assumption that California consumers of solvent-containing products have the same purchasing preferences as the general population of the U.S., may not be correct in all cases. Without extensive market research, far beyond the scope of this study, the validity of this assumption cannot be determined.

9.3.2 Uncertainties in Interpretation of Survey Results

The direct industrial solvent consumption and disposal survey constituted the data base from which total solvent use and emissions and individual solvent species market balances were constructed. Both the raw data and the values extrapolated from this data base are subject to considerable uncertainty. First, the solvent use rates reported by survey respondents varies from exact quantities supported by records of purchase to rough estimates based upon experience. In general, the largest solvent users kept the most detailed records, so that most of the reporting error was probably associated with a small percentage of the mass of solvent use reported.

The stratified scale-up approach descibed in Section 5.3 was reasonable, given the large variance in solvent use per firm. However, this approach is based upon the not always supportable assumption that the mean use per firm is significantly different for each firm size class defined by County Business Patterns. Also, because County Business Patterns does not report

data for four-digit SIC codes which have fewer than 50 employees in a county, the scale-up occasionally had to be performed at the three-digit SIC level, thus including many four-digit SIC codes which were not surveyed. Finally, as was discussed in Section 5.3.5, the firm size class corresponding to many firms which used no solvent was not known. Uncertainties in the scale-up from survey results were estimated by performing the calculation in different ways. Section 5.3.5 describes how we accounted for the problem of the no-solvent-use firms. Uncertainties in the estimates of direct industrial solvent use of individual species are presented in Section 7.4. Similarly, uncertainties in aggregate use and emissions at the county level are presented in Chapters 8 and this chapter.

APPENDIX A
SURVEY INSTRUMENTS

17 August 1982

Mr. Yoshio Kiyohiro
ALUM A FORM
18915 Laurel Park
Compton, CA 90220

Dear Sir:

Science Applications, Inc. (SAI) is under contract to the Research Division of the California Air Resources Board (ARB) to evaluate the accuracy of the statewide emission inventory for organic solvents. To assist us in our evaluation the ARB has furnished us with emission inventory records for 121 randomly-selected facilities, including yours. The objective of the present survey is to determine whether certain types of emission-related data for your facility are represented accurately in the inventory.

Enclosed are two survey forms. For information presently in the inventory, please indicate any changes, errors or omissions. We are also requesting information which is not in the inventory, but which is important to this study.

This request for data is a formal one made by the ARB pursuant to Section 41511 of the California Health and Safety Code and Section 91100, Title 17 of the California Administrative Code, which authorize ARB, or its duly appointed representative, to require the submission of air pollution related information from owners and operators of air pollution emission sources.

We understand that many firms are reluctant to furnish information which they consider to be privileged. The ARB has informed us that actual air pollution emission data cannot be classified as trade secrets, but other data such as privileged processes, costs, formulas, etc., may be eligible for such treatment. The information provided in the questionnaire can be released to the public upon request unless you request trade secret classification in writing (in accordance with the California Public Records Act, Government Code Section 6250 et seq.). All such requests must be accompanied by an adequate justification for the trade secret designation, which should be as detailed as possible without disclosing the trade secret.

Information supplied to ARB which is designated as a trade secret will be kept confidential, although such information may be forwarded to the U.S. Environmental Protection Agency, which protects trade secrets in accordance with federal law. Please note that SAI has formally agreed with the ARB to protect the disclosures of trade secrets to others. (See attachment.) Further information on ARB policy may be obtained from the ARB research contract monitor, Mr. Joseph Pantalone, whose telephone number is (916) 323-1535. Our contract number is A0-101-32.

We would appreciate it if you would return the survey forms within three weeks. I or one of my associates may want to visit your facility to discuss emission estimation procedures with your technical staff. Please indicate on the form whether such a visit will be feasible.

Thank you for your cooperation.

Sincerely,

SCIENCE APPLICATIONS, INC.

Michael B. Rogozen, D.Env.
Principal Investigator
ARB Emission Inventory Project

/m

STATE OF CALIFORNIA

EDMUND G. BROWN JR., Governo

AIR RESOURCES BOARD
1102 Q STREET
P.O. BOX 2815
SACRAMENTO, CA 95812

This letter is to confirm that Science Applications, Inc. (SAI) is under contract to the Air Resources Board (ARB) to perform an inventory of organic compound emissions in California. This contract, entitled "The Development and Improvement of Organic Compound Emission Inventories For California", requires the contractor to perform market balance computations for industrial and commercial solvents, taking into consideration the production, consumption and disposal of each of the chemical species of interest. As part of the market balance effort, SAI will conduct a survey of industries and establishmen concerned with the production, use and disposal of these organic compounds; the survey is to include distribution of the enclosed questionnaire to representative firms to determine their impact upon the inventory.

Science Applications, Inc. is required to preserve in strict confidence all information designated "trade secret" which is obtained from business entities during performance of this contract and may not retain, disclose, or in any other manner use such information except to report it to duly authorized members of the Air Resources Board staff. The ARB is required under State law to maintain the confidentiality of all information so designated.

The Air Resources Board appreciates your firm's cooperation with SAI in performance of this contract. We ask that you complete the questionnaire as soon as possible and return it to SAI.

Again, thank you for your cooperation.

Sincerely yours,

John R. Holmes

John R. Holmes, Ph.D.,
Chief, Research Division

SECRECY AGREEMENT

In consideration of the granting to Science Application, Inc. (hereafter "SAI") of ARB Contract No. A0-101-32 (hereafter "the Contract"), SAI agrees as follows:

1. In connection with SAI's activities under the Contract, SAI may obtain information directly from business entities, from the Air Resources Board (hereafter the "ARB"), or from local Air Pollution Control Districts which has been designated "trade secret" by a business entity.
2. SAI agrees to preserve in strict confidence all such information, and agrees that it will not use, disclose, or in any other manner use this information except as directed by duly authorized represertatives of the ARB.
3. SAI agrees to obtain from each of its employees who has access to such information a Secrecy Agreement in the form attached hereto as Exhibit A.
4. SAI agrees that upon completion of the Contract, it will promptly deliver to the ARB all such information, except as related to gross totals of categories of business entities developed from such information.
5. SAI agrees that it shall include with all such information supplied to the ARB having designation of "trade secret," the justification of trade secret, if any was supplied with such information.

Dated 7/22/81

Science Applications, Inc.

By: [signature]

Corporate Vice President

Dear Purchasing Agent:

Science Applications, Inc. (SAI) is currently under contract to the California State Air Resources Board (CARB) to update and improve the CARB's system for estimating and inventorying organic solvent emissions in California. As part of this research effort, we are attempting to obtain an independent estimate of the consumption and disposal of certain types of solvents in California during calendar year 1980.

After reviewing solvent use patterns, we have identified approximately 230 types of industries in which significant amounts of organic solvents are used. Your firm has been selected at random from a list of such companies. It would be of great help to our research if you would take a few moments to complete the enclosed Solvent Use and Disposal Questionnaire. All answers should correspond to your operations during calendar year 1980. Please be sure to include information on the number of employees engaged in manufacturing or service activities and the total number of personnel at your facility. Only facilities in California are to be included in the survey. (If you have no manufacturing plants or service facilities in California please check the corresponding box on the questionnaire and return the form anyway.)

We have attached copies of an authorizing letter from the CARB and a secrecy agreement signed by SAI. Please be assured that your response will be held in confidence. Results of our survey will be provided to the CARB in statistical summary form only, and the names of respondents will not be disclosed.

We would appreciate it if you would return the questionnaire in the enclosed stamped, self-addressed envelope within 30 days. If you have any questions please call Mr. Richard Rapoport, Ms. Maria Rodriguez or myself at (213) 553-2705. The CARB research contract monitor is Mr. Joseph Pantalone, who may be reached at (916) 323-1535.

Thank you very much for your cooperation.

Sincerely,

SCIENCE APPLICATIONS, INC.

Michael B. Rogozen

Michael B. Rogozen, D.Env.
Principal Investigator

SCIENCE APPLICATIONS, INC. / CALIFORNIA AIR RESOURCES BOARD

SOLVENT USE AND DISPOSAL QUESTIONNAIRE

Firm 6501

SIC _____

_____

_____

INSTRUCTIONS

Note: If your firm has no manufacturing facilities in California, please check here ☐ and return the questionnaire in the attached envelope. Thank you.

1. Please fill in one section of this form for each Standard Industrial Classification (SIC) code relevant to your operations. If you don't know your code(s), then briefly describe your product or service and we will determine the SIC number.
2. List all solvents you purchased for your operation and incorporate in your products. The attached list gives examples of the solvents commonly used in California. If your solvent type is not on the list, please report it anyway; we need to identify and quantify as many as possible. If you do not know the chemical name of the solvent, then please report the brand name and type (for example, Chevron 1200).
3. Give amount of solvent purchased for your operations and incorporated in your products in Calendar Year 1980. Specify whether amount is in pounds or gallons.
4. Indicate the means by which you dispose of the solvents you use; give the amounts of solvent disposed in Calendar Year 1980.

A-7

SIC Code (if known) _____ Type of Product or Service _____

No. of personnel engaged in this type of production or service (do not include administrative personnel) _____

Total number of personnel at your facility _____

Name of Solvent	Amount Purchased for 1980 Operations	Amount Incorporated in Product	Amount Disposed of in 1980	
			To Solvent Recycler	On-Site or Off-Site Disposal

SIC Code (if known) _____ Type of Product or Service _____

No. of personnel engaged in this type of production or service (do not include administrative personnel) _____

Total number of personnel at your facility _____

Name of Solvent	Amount Purchased for 1980 Operations	Amount Incorporated in Product	Amount Disposed of in 1980: To Solvent Recycler	Amount Disposed of in 1980: On-Site or Off-Site Disposal

5. Please state name and phone number of person to contact for more information.

_____

6. Thank you for your assistance. Questionnaires should be returned as soon as possible to:

Science Applications, Inc.
1801 Avenue of the Stars, Suite 1205
Los Angeles, California 90067
Attention: ARB Emission Inventory Project

COMMONLY USED SOLVENTS

Acetone
Amyl Acetate
Benzene
Butyl acetate
Butyl alcohol (butanol)
Isobutyl isobutyrate
Cellosolve
Cellosolve acetate
Chlorobenzene
Chloroform
Cyclohexane
Cyclohexanone
Diamene
Dichlorobenzene
Diethylene glycol
Dimethyl formamide
Dimethyl sulfoxide
Ethyl alcohol (ethanol)
Ethyl acetate
Ethyl benzene
Ethylene dichloride (EDC)
Ethylene glycol
Ethylene glycol monobutyl ether
Ethylene glycol monoethyl ether
Freon 11
Freon 113
Furfuryl alcohol
Heptane
Hexane
Hexylene glycol
Isooctane
Isopropyl acetate
Isopropyl alcohol (isopropanol)
Kerosene
Lactol spirits
Mesityl oxide
Methyl alcohol (methanol)
Methyl chloroform (1,1,1-trichloroethane)
Methyl ethyl ketone (MEK)
Methylene chloride
Methyl isoamyl ketone
Methyl isobutyl ketone (MIBK)
Methyl n-butyl ketone
Mineral spirits
Naphtha
Nitrobenzene
Nitropropane
Nonane
Octane
Perchloroethylene (perc)
Propyl acetate
Propyl alcohol (propanol)
Propylene glycol
Propylene oxide
Stoddard solvent
Toluene
1,1,1-trichloroethane
Trichloroethylene (TCE)
Triethanolamine
Triethylene glycol
VM + P Naptha
Xylene

STATE OF CALIFORNIA EDMUND G. BROWN JR., Governc

AIR RESOURCES BOARD
1102 Q STREET
P.O. BOX 2815
SACRAMENTO, CA 95812

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Science Applications, Inc. is required to preserve in strict confidence all information designated "trade secret" which is obtained from business entities during performance of this contract and may not retain, disclose, or in any other manner use such information except to report it to duly authorized members of the Air Resources Board staff. The ARB is required under State law to maintain the confidentiality of all information so designated.

The Air Resources Board appreciates your firm's cooperation with SAI in performance of this contract. We ask that you complete the questionnaire as soon as possible and return it to SAI.

Again, thank you for your cooperation.

Sincerely yours,

John R. Holmes

John R. Holmes, Ph.D.,
Chief, Research Division

SECRECY AGREEMENT

In consideration of the granting to Science Application, Inc. (hereafter "SAI") of ARB Contract No. A0-101-32 (hereafter "the Contract"), SAI agrees as follows:

1. In connection with SAI's activities under the Contract, SAI may obtain information directly from business entities, from the Air Resources Board (hereafter the "ARB"), or from local Air Pollution Control Districts which has been designated "trade secret" by a business entity.
2. SAI agrees to preserve in strict confidence all such information, and agrees that it will not use, disclose, or in any other manner use this information except as directed by duly authorized representatives of the ARB.
3. SAI agrees to obtain from each of its employees who has access to such information a Secrecy Agreement in the form attached hereto as Exhibit A.
4. SAI agrees that upon completion of the Contract, it will promptly deliver to the ARB all such information, except as related to gross totals of categories of business entities developed from such information.
5. SAI agrees that it shall include with all such information supplied to the ARB having designation of "trade secret," the justification of trade secret, if any was supplied with such information.

Dated 7/27/81

Science Applications, Inc.

By: [signature]

Corporate Vice President

Date 11/7/89

EMISSION INVENTORY ROUTE SLIP

TO	FROM	TO	FROM
___ RICH BRADLEY	___		
___ Katy Hicklin	___		

STATIONARY SOURCE SECTION

TO		FROM
___	RUSS TATE	^
___	Pacita Ayala	___
___	Vijay Bhargava	___
___	Tony Greer	___
___	Ranjit Grewal	___
___	Darryl Look	___
X	Chris Nguyen	___
___	Bob Weller	___

MV & PROJECTIONS SECTION

TO		FROM
___	ED YOTTER	___
___	Pranay Avlani	___
___	Agnes Daos	___
___	Cheryl Frazier	___
___	Irene Hui	___
___		___
___	Yosh Yajima	___

Comments: This is revised chapter 6.0 of the SAI report. We should let Joe Pantalone know if we find any problems in it.

6.0
INDIRECT SOLVENT CONSUMPTION

Solvents are present in a wide variety of formulations used in manufacturing, commercial enterprises and in the home. Use of these formulations, especially in consumer products, results in substantial solvent emissions. Since solvent contents vary in nature and magnitude from product to product, we began our analysis by defining the following product categories:

- Paints and other coatings
- Personal care products
- Household products
- Automotive products
- Industrial adhesives and sealants
- Other commercial products

Information on national use and solvent content of products in all but the last category was available. In this subsection we discuss our methodology for apportioning national values to California. Results for individual chemicals and for total solvent use are presented in Chapters 7 and 8, respectively.

6.1 PAINTS AND OTHER COATINGS

The National Paint and Coatings Association (NPCA) in Washington, DC, maintains an extensive data base on the use of solvents in coatings. SRI International (1980) recently used this data base to calculate the use of individual solvents and solvent groups by type and application of coatings. Table 6.1-1 shows the national breakdown of individual solvent use in 1979 according to the SRI study, while Table 6.1-2 summarizes the total solvent use in 1979 by application. (For ease in data presentation, Table 6.1-1 includes major coatings categories only; individual solvent use data for all subcategories were reported by SRI and used by SAI in the following method.)

To estimate California solvent use it was necessary first to adjust the national values to account for changes in use between 1979 and 1980, and

Table 6.1-1

NATIONAL USE OF INDIVIDUAL SOLVENTS IN PAINTS AND COATINGS, 1979
(All uses in millions of pounds)

Solvent Type	Product Finishes-OEM	Architec-tural	Special Purpose	Thinners Misc.	Total
Aliphatic hydrocarbons	345.3	436.0	162.8	150.9	1,095.0
Toluene	233.5	0.1	79.3	262.1	575.0
Xylenes	251.2	4.3	92.8	146.7	495.0
Other aromatics	78.6	-	36.6	74.8	190.0
n-Butyl alcohol	101.3	-	4.5	4.2	110.0
Ethyl alcohol	43.4	0.4	6.2	150.0	200.0
Isopropyl alcohol	56.0	-	7.7	63.3	127.0
Other alcohols	35.4	3.0	13.4	43.2	95.0
Acetone	49.6	-	9.7	130.7	190.0
Methyl ethyl ketone	129.4	-	35.3	202.3	367.0
Methyl isobutyl ketone	94.0	-	11.0	7.0	112.0
Ethyl acetate	31.5	-	33.8	46.7	112.0
Butyl acetate	48.7	-	31.6	17.7	98.0
Propyl acetate	24.7	-	17.3	11.0	53.0
Other ketones and esters	41.5	0.7	17.3	49.5	109.0
Ethylene glycol	4.3	57.0	0.1	-	61.4
Propylene glycol	0.2	38.1	-	-	38.3
Other glycols	-	1.2	-	-	1.2
Glycol ethers and ether esters	104.9	35.9	23.8	60.4	225.0
Methylene chloride	-	-	13.4	3.6	17.0
Others	29.0	-	5.0	7.0	41.0

Source: SRI, 1980.

Table 6.1-2

TOTAL NATIONAL SOLVENT USE IN PAINTS AND COATINGS, BY TYPE OF APPLICATION, 1979

(All quantities in millions of pounds)

Coating Category	Subcategory Use	Major Category Total	Subcategory Percent	Major Category Percent
PRODUCT FINISHES - OEM				
Wood Furniture & Fixtures	316.2		7.3	
Wood Flat Stock	116.4		2.7	
Metal Furniture & Fixtures	117.3		2.7	
Containers & Closures	187.4		4.3	
Sheet, Strip, & Coil	112.7		2.6	
Major Appliances	46.3		1.1	
Other Appliances	31.4		0.7	
Automotive				
Topcoat	93.1		2.2	
Primer	46.0		1.1	
Underbody Components & Parts	41.2		1.0	
Trucks & Buses	41.5		1.0	
Railroad	16.8		0.4	
Aircraft	15.7		0.4	
Machinery & Equipment	161.4		3.7	
Electrical Insulation	76.8		1.8	
Marine				
Pleasure	4.4		0.1	
Commercial & Maintenance	57.6		1.3	
Paper, Film & Foil	40.2		0.9	
Other Product Finishes	180.1		4.2	
Product-OEM Total		1,702.5		39.5
ARCHITECTURAL				
Interior Water-based				
Flat	29.2		0.7	
Semi-gloss & Gloss	51.9		1.2	
Other	3.5		0.1	
Interior Solvent-based				
Flat	46.8		1.1	
Semi-gloss & Gloss	73.5		1.7	
Varnish	16.1		0.4	
Other	39.9		0.9	

Table 6.1-2

TOTAL NATIONAL SOLVENT USE IN PAINTS AND COATINGS, BY TYPE OF APPLICATION, 1979 (Continued)
(All quantities in millions of pounds)

Coating Category	Subcategory Use	Major Category Total	Subcategory Percent	Major Category Percent
Exterior Water-based				
Flat(House Paints)	38.4		0.9	
Trim	3.6		0.1	
Stains	3.0		0.1	
Other	4.1		0.1	
Exterior Solvent-based				
Flat (House Paints)	82.7		1.9	
Enamel	62.3		1.4	
Primer	25.8		0.6	
Varnish	14.4		0.3	
Stains	68.1		1.6	
Other	13.4		0.3	
Architectural Total		576.7		13.4
SPECIAL PURPOSE COATINGS				
Maintenance	118.8		2.8	
Auto Refinishing	192.4		4.5	
Other Refinishing	42.7		1.0	
Traffic Paints	147.9		3.4	
Other	99.8		2.3	
Special Purpose Total		601.6		14.0
Thinner & Miscellaneous		1,431.0		33.2
PAINTS & COATINGS TOTAL		4,311.8		100.0[a]

Source: SRI, 1980.

[a] Sum of subcategory percentages equals 100.1 due to rounding error.

then to apportion the 1980 figures from national to California use rates. The general formula for this apportionment was:

$$U_{C,i,j,80} = U_{N,i,j,79} \left(\frac{A_{N,j,80}}{A_{N,j,79}} \right) \left(\frac{A_{C,j,B}}{A_{N,j,B}} \right) \qquad (6.1\text{-}1)$$

where

$U_{C,i,j,80}$ = California use of solvent i in coatings category j in 1980,

$U_{N,i,j,79}$ = National use of solvent i in coatings category j in 1979,

$A_{N,j,79}$ and $A_{N,j,80}$ = National value of adjustment parameter for coatings category j in 1979 and 1980, respectively,

$A_{N,j,B}$ = National value of adjustment parameter for coatings category j in a base year, and

$A_{C,j,B}$ = California value of adjustment parameter for coatings category j in the same base year

The adjustment parameters are measures of activity levels which could reasonably be expected to influence solvent use in a particular category. As will be seen below, they include production worker hours, number of homes, population, and other measures. One can restate Equation 6.1-1 as:

$$U_{C,i,j,80} = U_{N,i,j,79} \, P_j \qquad (6.1\text{-}2)$$

where

$$P_j = \left(\frac{A_{N,j,80}}{A_{N,j,79}} \right) \left(\frac{A_{C,j,B}}{A_{N,j,B}} \right) \qquad (6.1\text{-}3)$$

With three exceptions, we assume that a single proportionation factor, P_j, applies to all the solvents used in a given coatings category. This assumption may not be valid in the case of architectural coatings, since state and local district regulations have in recent years tended to favor the use of water-based coatings, whose solvent speciation differs from that of oil-based coatings. Solvent-specific proportionation factors were calculated for maintenance coatings, other special purpose coatings, and thinners. The rationale for their calculation is discussed below.

Table 6.1-3 shows the adjustment factors and base years used to calculate the proportionation factor for each coatings category. (Coatings category numbers are defined in Table 6.1-4.) The first step was to identify the industries in which each type of coating is most likely to be used. Most Standard Industrial Classification (SIC) codes were provided in the SRI report; where they were missing, we chose those which were, in our judgment, most appropriate. The base year (corresponding to the subscript B in Equations 6.1-1 and 6.1-3) was the latest for which relevant data were available for both California and the U.S. In most cases this was 1977, since that was the last year for which California-specific data were published by the Census Bureau (U.S. Census Bureau, 1980b).

Some aggregation of the NPCA coatings categories was necessary. For example, the Census of Manufactures does not report production worker hours for California for the appliance industry. We therefore used the three-digit SIC code 363 (household appliances) to cover the NPCA categories "major appliances" and "other appliances." Interior use of architectural coatings was assumed to be proportional to the number of households, including owner-occupied and rental units. The number of households was, in turn, assumed to be proportional to population. The category "other refinishing," includes refinishing of machinery, equipment, and other hardware. No SIC code can be readily identified with this use of coatings. We assumed that the quantity of coatings used in refinishing was proportional to that used in original machinery and equipment manufacture.

Three coatings categories required special treatment. We assumed that California use of solvents in maintenance coatings bore the same ratio to total California use in original equipment manufacture (OEM) as national use in maintenance coatings had to national OEM use in 1979. OEM uses include coatings categories 1 through 15. Rearranging the terms of this pair of ratios, we see that:

$$U_{C,i,21} = \left(\sum_{j=1}^{15} U_{C,i,j}\right) (U_{n,i,21}) / \left(\sum_{j=1}^{15} U_{N,i,j}\right) \qquad (6.1\text{-}4)$$

Table 6.1-3

DATA USED TO CALCULATE PROPORTIONATION FACTORS
FOR CALIFORNIA SOLVENT USE IN COATINGS

Coatings Category[a] j	Standard Industrial Classification Codes	Adjustment Parameter	$A_{N,j,79}$	$A_{N,j,80}$	Base Year	$A_{C,j,B}$	$A_{N,j,B}$	Ref.[b]
1	2511,2512,2517 2521,2541	MPWH[c]	483.8	456.1	1977	46.05	447.5	1,2
2	2451, 2452, 2492	MPWH	127.8	100.9	1977	15.9	132.0	1,2
3	2514, 2522, 2542	MPWH	145.8	138.7	1977	16.8	135.7	1,2
4	3411, 3412	MPWH	123.6	114.5	1977	18.3	126.5	1,2
5	3479	MPWH	61.4	60.9	1977	5.8	52.2	1,2
6	363[d]	MPWH	229.2	227.0	1977	7.3	243.2	1,2
7	-	1000 Autos produced	8,434	6,376	1980	261.2	6,376	3
8	3713	MPWH	54.9	54.8	1977	4.4	54.8	1,2
9	3743	MPWH	108.4	90.4	1977	0.6	79.4	1,2
10	3721,3724,3728	MPWH	674.3	653.3	1977	98.3	475	1,2
11	352, 353, 354, 355, 356, 357, 3581, 3585, 3586	MPWH	2,551.8	2,444.0	1977	154.12	2,223.8	1,2
12	3612, 3613, 3621	MPWH	334.4	299.3	1977	15.4	307.3	1,2
13	3731, 3732	MPWH	340.1	343.6	1977	35.4	345.6	1,2

Table 6.1-3 (Continued)

DATA USED TO CALCULATE PROPORTIONATION FACTORS
FOR CALIFORNIA SOLVENT USE IN COATINGS

Coatings Category[a] j	Standard Industrial Classification Codes	Adjustment Parameter	$A_{N,j,79}$	$A_{N,j,80}$	Base Year	$A_{C,j,B}$	$A_{N,j,B}$	Ref.[b]
14	3479	MPWH	61.4	60.9	1977	5.8	52.2	1,2
15	3479	MPWH	61.4	60.9	1977	5.8	52.2	1,2
16	-	1000 single-family homes	57,005	58,290	1980	5,725	58,290	4
17	-	1000 persons	224,567	e	1980	23,669	e	2
18	-	1000 autos registered	120,248	121,724	1980	13,268	121,724	3
19	Same as 11	MPWH	2551.8	2,444.0	1977	154.12	2,223.8	1,2
20	-	1000 miles	3,918.8	3,955.4	1980	180.7	3,955.4	5

[a] See Table 6.1-4 for definitions of coatings categories.

[b] References: 1-US Census Bureau, 1977; 2-US Census Bureau, 1980b; 3-Motor Vehicles Manufacturing Association, 1982; 4-US Department of Housing and Urban Development, 1982; 5-US Federal Highway Administration, 1982.

[c] MPWH = Million production worker hours.

[d] In order to maintain confidentiality, the Census Bureau reports data at the three-digit SIC level only.

[e] In this case the adjustment factors $A_{N,17,80}$ and $A_{N,17,B}$ are equal and therefore cancel out. (See Equation 6.1-1).

Table 6.1-4

FACTORS USED TO PROPORTIONATE 1979 NATIONAL SOLVENT USE IN COATINGS TO 1980 CALIFORNIA USE

Category Number j	Coatings Category	Proportionation Factor P_j
1	Wood furniture and fixtures	0.09701
2	Wood flat stock	0.09510
3	Metal furniture and fixtures	0.1178
4	Containers and closures	0.1340
5	Sheet, strip and coil	0.1102
6	Appliances	0.02973
7	Automotive	0.03098
8	Trucks and buses	0.08160
9	Railroad	0.00630
10	Aircraft	0.2005
11	Machinery and equipment	0.06640
12	Electrical insulation	0.04485
13	Marine	0.1035
14	Paper, film and foil	0.1102
15	Other product finishes	0.1102
16	Architectural/interior	0.1054
17	Architectural/exterior	0.1004
18	Auto refinishing	0.1103
19	Other refinishing	0.06640
20	Traffic paints	0.04612
21	Maintenance	a
22	Other special purpose	a
23	Thinners and miscellaneous	a

[a] Varies with solvent type. See text.

California use of "other special purpose" coatings was assumed to bear the same ratio to total California special purpose coatings (categories 18 through 22) as national other special purpose coatings bore to national total special purpose coatings. We can express this relationship as follows:

$$\frac{U_{C,i,22}}{\left(\sum_{j=18}^{21} U_{C,i,j}\right) + U_{C,i,22}} = \frac{U_{N,i,22}}{\sum_{j=18}^{22} U_{N,i,j}} \qquad (6.1\text{-}5)$$

Solving Equation 6.1-5 for $U_{C,i,22}$ we obtain:

$$U_{C,i,22} = \frac{(U_{N,i,22}) \sum_{j=18}^{21} U_{C,i,j}}{\left(\sum_{j=18}^{22} U_{N,i,j}\right) - U_{N,i,22}} \qquad (6.1\text{-}6)$$

Similarly, the ratio of California use of solvents in the "thinners and miscellaneous" category to the total solvent use for coatings in California was assumed to equal the corresponding national ratio. The value for $U_{C,i,23}$ was therefore:

$$U_{C,i,23} = \frac{(U_{N,i,23}) \sum_{j=18}^{22} U_{C,i,j}}{\left(\sum_{j=1}^{22} U_{N,i,j}\right) - U_{N,i,23}} \qquad (6.1\text{-}7)$$

Note that in these last three categories, the proportionation factor P will be different for each solvent species.

Table 6.1-4 lists the proportionation factors used by SAI. Note that the common rule-of-thumb that California accounts for about 10 percent of the use of various industrial and consumer products applies for several coatings categories, but by no means all. Given the state's large aircraft and

aerospace industry, it is not surprising that P_{10} is about 0.20. Appliances, automobile manufacturing, and several other coatings categories account for considerably less than 10 percent of the national total solvent use.

Finally, Table 6.1-5 shows the estimated total California use of solvents in paints and coatings for each coating subcategory. This use consists of 262 million lbs (131,000 tons) included in the coatings and 130 million lbs (65,000 tons) as thinners, for a total of 392 million lbs (196,000 tons). The proportionation factors in Table 6.1-4 were also used to estimate use of individual solvent species. Results of the calculation for each chemical are presented in Chapter 7.

6.2 PERSONAL CARE PRODUCTS

The principal personal care products found by our literature review to have significant solvent contents were:

- Nail care items (including polish remover)
- Shaving cream
- Deodorants
- After shave lotions
- Pre-shave lotions

Perfume sticks and electric shaver cleaners may contain propylene glycol (Gosselin, 1976). However, no data on perfume stick use could be found, and a market research study by Simmons Market Research Bureau (1980) indicated that shaver cleaner use is negligible. Similarly, methylene chloride is an ingredient of one brand of men's hair spray, but its use is insignificant. Our procedure for estimating solvent emissions from each of these categories was as follows.

6.2.1 Nail Care

As with many consumer products, formulation information other than that stated on labels is not readily available. Some data for specific pro-

Table 6.1-5

TOTAL CALIFORNIA SOLVENT USE IN PAINTS AND COATINGS, BY TYPE OF APPLICATION, 1980
(All quantities in millions of pounds)

Coating Category	Subcategory Use	Major Category Total	Subcategory Percent	Major Category Percent
Product Finishes - OEM				
Wood Furniture and Fixtures	30.676		7.84	
Wood Flat Stock	11.070		2.83	
Metal Furniture and Fixtures	13.815		3.53	
Containers and Closures	25.114		6.42	
Sheet, Strip and Coil	12.420		3.17	
Appliances	2.310		0.59	
Automotive	5.585		1.43	
Trucks and Buses	3.346		0.85	
Railroad	0.106		0.03	
Aircraft	3.148		0.80	
Machinery and Equipment	10.716		2.74	
Electrical Insulation	3.445		0.88	
Marine	6.416		1.64	
Paper, Film and Foil	4.430		1.13	
Other Product Finishes	19.848		5.07	
Product-OEM Total		152.445		38.95
Architectural				
Interior	27.498		7.03	
Exterior	31.716		8.11	
Architectural Total		59.214		15.14
Special Purpose				
Auto Refinishing	21.229		5.42	
Other Refinishing	2.835		0.72	
Traffic Paints	6.821		1.74	
Maintenance	10.675		2.73	
Other	8.397		2.15	
Special Purpose Total		49.957		12.76
Thinners		129.688		33.14
Grand Total		391.304		100.0

ducts and two general formulations are presented in Gosselin (1976). The Cosmetic, Fragrance and Toiletry Association was contacted for additional information (Kimball, 1982). Table 6.2-1 shows the solvent content of major nail polish types, as determined by SAI. Virtually all types of nail coatings contain butyl acetate, toluene and ethyl acetate. While xylene is present in some brands of polish, it is absent from most popular brands (e.g. Revlon™, Sally Hansen™ and Cover Girl™).

According to a survey performed by the Simmons Market Research Bureau (1980), 63.7 percent of adult females either apply nail polish themselves at home or have their nails done at salons; since there are 8.440×10^6 adult females in California (Mielke, 1982), 5.376×10^6 meet this description. Since nail care product use patterns are different for home use and at salons, it was necessary to estimate how many women fall into each category. In a survey conducted by Modern Salon (1982), 81 percent of the women interviewed said that they did their own nails, 9 percent had them done at salons only, and 10 percent did them at home and at salons. We assume that these percentages apply to adult females in general (i.e. not just to those who have their hair done at salons). The number of women in each category is therefore:

$$\text{Home only} = 5.376 \times 10^6 \ (81)/(81 + 10) = 4.785 \times 10^6$$
$$\text{Home or salon} = 5.376 \times 10^6 \ (10)/(81 + 10) = 5.91 \times 10^5$$
$$\text{Salon only} = 5.91 \times 10^5 \ (9/10) = 5.32 \times 10^5$$

In addition the Simmons Market Research Bureau study showed that one quarter of the California females in the 15-19 year-old population, or 2.596×10^5 persons, do their own nails at home.

The number of bottles of each coating type consumed by each type of user was determined as the number of users x frequency of nail care x frequency of use of coating type x fraction of a bottle per use. Frequency of nail care was determined by the Simmons Market Research Bureau survey, discussions with salons, and an informal survey of SAI staff. It was assumed that clear enamel is used 25 percent of the time, and only in salons. The service limit of a typical bottle was assumed to be 20 applications. Table 6.2-2 shows the results of our consumption estimates.

Table 6.2-1

ORGANIC SOLVENT CONTENT OF MAJOR BRANDS OF NAIL POLISH
(Percent by weight)

Type	Butyl Acetate	Ethyl Acetate	Toluene	Xylene
General polish	17.8 - 31.4	13.1 - 28.4	2.5 - 26.8	0 - 8.7
General top coat	21.3	14.6	30.6	10.1
Avon Clear Nail[tm]	19.7	13.2	27.2	8.7
Avon base coat	17.7	30	28	-
Cutex polish	25 - 50	10 - 25	10 - 25	-
Nail lacquer	15	35	20	-
Other brands[a]	20	25	20	-

Source: Gosselin (1976) and Cosmetic, Fragrance and Toiletry Association (Kimball, 1982).

[a] SAI estimate.

Table 6.2-2

CALCULATION OF BOTTLES OF NAIL CARE PRODUCTS CONSUMED IN CALIFORNIA

Location of Use	1000 Persons	Frequency (times/yr)	1000 Bottles Consumed: Nail Enamel	Clear Enamel	Base Coat	Top Coat
Home only (adults)	4,785	43.2	10,335.6	-	-	
Home only (15-19)	260	18	233.6	-	-	
Salons only	532	36	718.2	119.7	478.8	119.7
Home and salons	591	12	266.0	44.3	177.3	44.3
Total Consumption			11,553.4	164.0	656.1	164.0

The density of all nail polishes was assumed to be approximately 1 g/cm^3. Since the average bottle is 0.5 oz, the average weight per bottle is 0.033 lb. Using this information, as well as the solvent composition data presented in Table 6.2-1, we estimated total use of solvent in nail polishes in California in 1980 to be 272,000 lb (136 tons). Consumption of individual solvents is discussed in Chapter 7.

Finally, we considered use of acetone in nail polish remover. The solvent content of these products is roughly 50 percent (Gosselin, 1976). From a random sample of SAI staff, we estimate that about 0.1 oz of remover is used for every application of nail coating. Given the application frequencies listed in Table 6.2-2 we estimate that there were 2.4×10^8 applications of nail coatings in California. Assuming a polish remover density of 1 g/cm^3 (8.345 lb/gal), we estimate an acetone use of 800,000 lb (400 tons).

6.2.2 Shaving Cream

The only major solvent of interest in shaving cream is propylene glycol, which, according to Gosselin (1976), is present at between 0 and 15 percent by weight; we used 5 percent in our calculations. The only brand containing propylene glycol is Colgate "Instant Shave," which is preferred by 18.5 percent of the men and 31.0 percent of the women who use any shaving cream (Simmons Market Research Bureau, 1980). According to the cited study, 60.8 percent of males and 17.9 percent of females use shaving cream, and the use frequencies are 273 and 101 uses per year, respectively. According to the Gillette Medical Evaluation Laboratory (Wernick, 1982) the average weight per use of shaving cream is 5 g. Using this information, along with the California male and female populations, we estimated propylene glycol use to be 140,000 lb (70 tons) per year.

6.2.3 Deodorant

Stick deodorants contain 4 to 5 percent propylene glycol by weight, while aerosol products contain an average of 1.5 percent, according to an in-

dustry source. None of the roll-on deodorants or antiperspirants on the market contain solvents of interest. According to the Simmons Market Research Bureau (1980), 87.4 percent of males and 92 percent of females use deodorants, and their use rates are 400.9 and 427.7 times per year per person, respectively. As seen in Table 6.2-3, approximately 140,000 lb/yr (70 tons/yr) of propylene glycol is used in deodorants in California.

6.2.4 After Shave and Electric Pre-Shave Lotion

After shave products consist mainly of denatured alcohol and propylene glycol. In our analysis, we assumed that the denatured alcohol was essentially ethanol. Three brands of after shave lotion, accounting for 44.5 percent of the market, contain propylene glycol (Simmons Market Research Bureau, 1980). According to a representative of the Cosmetic, Fragrance and Toiletry Association (Kimball, 1982), one can get an average of 35 uses per ounce. Other market data show that 72.4 percent of the adult male population uses after shave lotion, and that the use frequency is 312 times per year. Using this information, we estimate that ethanol and propylene glycol use in these products are 2.7 million lbs/yr (1,340 tons/yr) and 30,500 lb/yr (15.3 tons/yr), respectively.

Only one brand of electric pre-shave lotion, accounting for 12.5 percent of the market, contains propylene glycol. Using other market research information, we estimated that ethanol and propylene glycol use are 340,000 lb (170 tons) and 1,100 lb (0.5 tons) per year, respectively.

6.2.5 Rubbing Alcohol

The main constituent of rubbing alcohol is isopropanol, which is normally present at 70 percent by volume. National sales of rubbing alcohol in 1980 were $37,697,000 (Anon., 1981a). We assume that California sales were in proportion to the state's share of U.S. households, or 10.762 percent (Anon., 1981b). From an SAI survey of rubbing alcohol prices on drugstore shelves, we assume an average price of $1 per pint bottle. Given the density of isopropanol, we estimate total use (and consequent evaporation) in California of 2.3 million lb (1,150 tons).

Table 6.2-3

CALCULATION OF PROPYLENE GLYCOL USE IN DEODORANTS

Population Category	Product Type	Total Users of Deodorants	Product User Fraction[a]	Product Uses[b]	Pounds per Use[c]	Solvent Fraction	Solvent Use (lb/yr)
Males	Stick	7.13×10^6	0.441	1.26×10^9	1.9×10^{-3}	0.045	1.1×10^5
Males	Aerosol	7.13×10^6	0.101	2.89×10^8	2.4×10^{-3}	0.015	1.0×10^4
Females	Stick	7.96×10^6	0.0413	1.41×10^8	1.9×10^{-3}	0.045	1.2×10^4
Females	Aerosol	7.96×10^6	0.0942	3.21×10^8	2.4×10^{-3}	0.015	1.2×10^4
Totals				2.01×10^9			1.4×10^5

[a] Based on market share of those brands containing propylene glycol (Simmons Market Research Bureau, 1980).

[b] Based upon 400.9 and 427.7 uses per year by males and females, respectively (Simmons Market Research Bureau, 1980).

[c] Based on discussions with a major producer.

6.3 HOUSEHOLD PRODUCTS

6.3.1 General Purpose Cleaners

The Simmons Market Research Bureau (1980) study showed that 89.2 percent of households use general purpose cleaning proudcts. Another survey (Anon., 1981b) estimated that there were 8.814 million households in California in 1980. Review of other market data showed that the average household buys 3.4 packages of cleaning products. Three major brands of cleaners, accounting for 33.8 percent of the market, use ethylene glycol monobutyl ether. Average weight percentages of solvents were found in Gosselin (1976). Since packages of each brand come in more than one size, SAI staff examined supermarket stock to determine the average weight per package sold. Since these products are at least 90 percent water, it was assumed that the total product density was 8.345 lb/gal. Table 6.3-1 shows how the California solvent use was determined for each brand. Total use of ethylene glycol monobutyl ether in household cleaners is estimated to be 700,000 lb (350 tons) per year.

6.3.2 Window Cleaners

Ethylene glycol monoethyl ether is the main solvent of interest in window cleaners, which are used in 84.4 percent of households. Isopropyl alcohol is used in one brand. As in the case of general purpose cleaners, we surveyed supermarket store shelves to determine average weights per package for major brands. Other data were obtained from the Simmons Market Research Bureau (1980) and Gosselin (1976). Again, total product density was assumed to be 8.345 lb/gal. Table 6.3-2 shows how the California solvent use was determined for each brand. Total use of ethylene glycol monoethyl ether and isopropyl alcohol in window cleaners are estimated to be 1.2 million lb (600 tons) and 420,000 lb (210 tons) per year, respectively.

6.3.3 Spot Removers

Solvents in spot removers consist mainly of petroleum solvents, aromatic hydrocarbons and chlorinated hydrocarbons. Composition data for common

Table 6.3-1

ESTIMATION OF ETHYLENE GLYCOL MONOBUTYL ETHER USE
IN GENERAL PURPOSE HOUSEHOLD CLEANERS

Brand	Market Share	Packages Sold	Ave. Wt. per Package (lb)[a]	EGMBE Fraction	EGMBE Used (lb)
Dow	0.0885	2.27×10^6	1.3	0.06	1.8×10^5
Fantastik	0.1464	3.91×10^6	1.8	0.045	3.2×10^5
Formula 409	0.1064	2.84×10^6	2.0	0.035	2.0×10^5
Totals		9.02×10^6			7.0×10^5

[a] Determined from SAI survey of market shelves

Table 6.3-2

ESTIMATION OF ETHYLENE GLYCOL MONOETHYL ETHER USE
IN WINDOW CLEANERS

Brand	Market Share	Containers Sold	Ave. Wt. per Container (lb)[a]	EGMEE Fraction	EGMEE Used (lb)
Ajax	0.069	1.63×10^6	1.0	0.03	4.9×10^4
Glass Plus	0.253	5.98×10^6	3.1	0.025	4.6×10^5
Windex	0.597	1.41×10^7	1.0	0.05[b]	7.0×10^5
Totals		2.17×10^7			1.2×10^6

[a] Determined from SAI survey of market shelves

[b] Ethylene glycol monoethyl ether and isopropanol assumed to share equally the 10-percent solvent content reported by Gosselin (1976).

brands were obtained from Gosselin (1976) and from product labels; those for three major brands are shown in Table 6.3-3. According to a study by Supermarket Business staff (Anon., 1981c), the 1980 U.S. retail market for spot removers was $30,450,000. California accounted for 11.2 percent of national retail sales; assuming that this proportion applies to spot removers, the amount spent on this product in the state would be $3,410,400. SAI staff surveyed the shelves of two major supermarkets and drugstores to determine the average unit price for each brand. These prices, along with the market fraction of each brand, are shown in Table 6.3-4. The number of units of each brand sold in California was estimated in the following manner.

Let B_i be the number of units of brand i sold in California and let P_i be the corresponding unit price. Then B_iP_i = $3,410,400. If the subscripts 1 through 4 correspond to K2R™ aerosol, K2R™ paste, Carbona™ liquid and the combination of Energine™ and Renuzit™, respectively, then the following relationships may be seen from the market share information presented in Table 6.3-4:

$$B_2 = 10B_1$$

$$B_3 = \frac{0.123}{0.5482} B_1 = 0.2244\ B_1$$

$$B_4 = \frac{0.274}{0.5482} B_1 = 0.4998\ B_1$$

Using the unit price information, we can set up and solve the following equation for B_1:

$$B_1\ (1.79) + 0.10B_1\ (1.19) + 0.2244B_1\ (1.39) + 0.4998\ (1.39) = 3,410,400$$

$$B_1 = 1,169,692 \text{ units sold}$$

The number of units of the other brands, along with the weights of each unit, are shown in Table 6.3-4. Carbona™ liquid was assumed to have a specific gravity of 0.8. For the three brands whose solvent composition was known, the

Table 6.3-3

SOLVENT CONTENT OF MAJOR BRANDS OF SPOT REMOVERS
(Percent by weight)

Brand	Aliphatic Hydrocarbon	Methyl Chloroform	Methylene Chloride	Perchloro-ethylene	Toluene	Trichloro-ethylene	Xylene
Carbona Liquid[a]	50	10	-	-	-	40	-
K2R Aerosol	-	25	15	16	-	-	-
K2R Paste	10	16	27	17	15	-	15

[a] Assumed to have same composition as Carbona aerosol, which was not found on the shelves in SAI's supermarket survey

Table 6.3-4

MARKET SHARE OF MAJOR BRANDS OF SPOT REMOVERS

Brand	Market Fraction	Unit Price[b] ($)	Unit Weight (oz)	Estimated Units sold in California
K2R Aerosol	0.5482[c]	1.79	6	1.2×10^6
K2R Paste	0.0548[c]	1.19	0.8	1.2×10^5
Carbona Liquid	0.123	1.39	4	2.6×10^5
Energine Renuzit	0.274	1.39	4	5.8×10^5
Totals	1.000			2.2×10^6

[a] Simmons Market Research Bureau (1980).

[b] SAI survey of supermarkets and drug stores.

[c] The market fraction for aerosol and paste combined was 0.603; we observed that the paste appeared on the shelves with one-tenth the frequency of the aerosol.

use of each solvent was calculated as the product of the units sold, the unit weight and the solvent fraction. For example, methyl chloroform use in K2R™ paste is estimated to be (116,969 units)(0.8 oz/unit)(1b/16 oz)(0.16) = 936 lb. Since no composition data were available for two of the brands, the total for the state was computed by multiplying solvent use for the three known brands by the reciprocal of their combined market share. We thus estimate that spot remover use in California results in use of 38,500 lb (19.3 tons) of aliphatic hydrocarbons, 160,000 lb (80 tons) of methyl chloroform (1,1,1-trichloroethane), 93,000 lb (46.5 tons) of methylene chloride, 98,000 lb (49 tons) of perchloroethylene, 1,200 lb (0.6 tons) of toluene, 30,000 lb (15 tons) of trichloroethylene, and 1,200 lb (0.6 tons) of xylene; total solvent use is 421,900 lb (211 tons).

6.3.4 Ball Point and Porous Tip Pens

Information on the amount of ink in, and the solvent composition of, fine line porous tip, other porous tip (except marking), rolling point and broad tip marking pens was obtained from the Federal Bureau of Alcohol, Tobacco and Firearms (Cantu, 1982) and from two major pen manufacturers (Kuranz, 1982; Anon, 1982a). Inks used in ballpoint pens (including disposable pens and refills) must have high viscosity and thus contain high-molecular-weight glycols and glycol ethers. Since the air pollution potential of these inks is negligible, they were not included in our estimations. The principal solvent in the remaining types of pens used by consumers is ethylene glycol, although glycol ethers are used in some pens with water-based inks.

Sales data were obtained from two market surveys (Anon., 1982a; Anon., 1981c). Although these surveys contained much valuable data, no information was available for fountain pen ink sales. Also, it is uncertain whether commercial use of pens (e.g. large-lot purchases by offices) is included. Thus our estimates will probably be lower than the actual values.

Table 6.3-5 summarizes the information obtained for the four main types of pen. Average prices were determined by an SAI survey of two supermarkets, two drug stores and one office supply store. California sales were assumed to be 11.2 percent of national sales. Ethylene glycol use in pens is estimated to be 37,000 lb/yr (18 tons/yr).

Table 6.3-5

ESTIMATION OF ETHYLENE GLYCOL USE IN PENS

Type of Pen	Estimated California Sales ($)	Average Retail Price ($)	Units Sold in California	Wt. of Ink in Pen (g)	Solvent Fraction	Solvent Used (lb)
Fine line porous tip	2.10×10^7	0.89	2.36×10^7	1.5	0.175	1.4×10^4
Other porous tip	9.07×10^6	0.89	1.02×10^7	2	0.175	7.9×10^3
Rolling point	1.42×10^7	0.79	1.80×10^7	1.5	0.175	1.0×10^4
Broad tip marker	6.27×10^6	0.76	8.25×10^6	5	0.06	5.5×10^3
Totals	5.05×10^7		6.01×10^7			~~3.7×10^4~~ 13.7×10^4

6.3.5 Household Adhesives Use

Results of an adhesives sales survey undertaken by a trade association were provided to SAI with the condition that the source not be identified. The survey did not include all adhesives producers in the country and would therefore be expected to underpredict total sales. According to the survey, 27.7 million lb of solvent-based adhesives and 22.1 million lb of solvent-based sealants were used by households in 1981. (Data for 1980 were unavailable.) If we assume that California use is proportional to population, then 10.1 percent of these amounts were used in the state. Table 6.3-6 shows the solvent content of various domestically-used adhesives, according to Gosselin (1976). Unfortunately data on neither the relative use of the different adhesives types nor the solvent composition of sealants were available. From the composition data shown in Table 6.3-6, we estimate use of 370,000 lb (185 tons) of acetone, 12,000 lb (6 tons) of butyl acetate, 63,000 lb (31.5 tons) of ethyl acetate, 600,000 lbs (300 tons) of hexane and 380,000 lb (190 tons) of toluene, for a total solvent use of 1.4 million lb (710 tons) of solvents in domestic adhesives. The use of solvents in sealants will not be estimated, but is probably of the same order of magnitude.

6.4 AUTOMOTIVE PRODUCTS

The most important solvent-containing automotive products are radiator antifreeze, windshield washer and gasoline line antifreeze, and brake fluid. Other products are shown in Gosselin (1976) as containing solvents of interest to this study. However, perusal of product labels showed that these solvents are no longer widely used.

6.4.1 Radiator Antifreeze

Cooling system antifreeze products are based on ethylene glycol, which both depresses freezing points and elevates boiling points. Antifreezes used today are changed as needed, rather than at the end of the winter season. Ernst and Whinney (1981) surveyed 11 ethylene glycol-based antifreeze manufacturers for the Chemical Specialties Manufacturers Association. National sales to civilian and government consumers in 1980 were 184.3 million gallons. No breakdown by vehicle type was reported.

Table 6.3-6

SOLVENTS CONTAINED BY COMMON TYPES OF ADHESIVES
(Values are percent by weight)

Adhesive Type	Acetone	Butyl Acetate	Ethyl Acetate	Hexane	Toluene
Nitrocellulose cement	39	-	-	-	-
China cement[a]	20 - 40	0 - 5	UA[b]	UA	20 - 30
Rubber cement	UA	-	-	90	UA
Leather glue	-	-	5	25	45
Metal cement	15 - 25[c]	-	-	-	-
Model cement	30 - 85	d	20 - 25	30	20 - 25

Source: Gosselin, 1976

[a] Also contains methyl ethyl ketone, butanol, and methyl isobutyl ketone.

[b] UA = unspecified amount.

[c] May contain other ketones.

[d] Butyl acetate sometimes used.

6.4.3 Brake Fluid

Brake fluid about 85 percent ethylene glycol monoethyl ether by weight (Gosselin, 1976). The heaviest use of these products is in the original manufacture of the automobile and in replacing master cylinders. According to our discussions with automobile dealers, new automobiles and small trucks require about one quart of brake fluid, while medium and large trucks may require somewhat more. According to the U.S. Census Bureau's Industry Division (McGrath, 1982), 261,242 automobiles were built in California in 1980. Using production worker hour data (See Section 6.1), we estimate production of 130,750 trucks and buses in that year. Thus use of brake fluid in new vehicles would be 98,000 gallons. The solvent content of that volume would be 650,000 lb.

To estimate use of brake fluid in master cylinder replacement, we held discussions with automobile repair shops. Table 6.4-1 shows our estimate of the frequency of repair of vehicles of various ages. Total California vehicle registration and age distribution data were obtained from the State Department of Transportation (CDOT, 1981; Hoyt, 1982). The brake fluid was assumed to have the same density as the solvent. Master cylinder replacement results in the use of 1.7 million lb (850 tons) statewide. The total ethylene glycol monoethyl ether use in brake fluids in 1980 was 2.4 million lb (1,200 tons).

6.4.4 Other Automotive Products

Gasoline additives, carburetor cleaners, spray de-icers and engine cleaners contain solvents, including petroleum distillate, glycol ethers, ethylene glycol, methanol and xylene. Sales data for these products were unavailable. From very limited market data on two carburetor cleaners, we estimate use of 9,000 lb (4.5 tons) of xylene in this category.

6.5 INDUSTRIAL ADHESIVES AND SEALANTS

As noted above, information on a national survey of adhesives and sealants sales was provided by an industry source who wished to remain anony-

Table 6.4-1

ESTIMATION OF ETHYLENE GLYCOL MONOETHYL ETHER
USE IN MASTER CYLINDER REPLACEMENT

Age of Vehicle (years)	Pct. of Registered Vehicles[a]	Pct. Needing Master Cylinder Replacement	Brake Fluid (gal)	EGMEE Use (lb)
4 - 5	16.3	0	0	0
6 - 7	15.6	5	2.9×10^4	1.9×10^5
8 - 9	12.2	10	4.6×10^4	3.0×10^5
10 - 11	10.0	15	5.6×10^4	3.7×10^5
12 - 13	6.6	20	5.0×10^4	3.3×10^5
>13	10.4	20	7.8×10^4	5.2×10^5
Total			2.6×10^5	1.7×10^6

[a] Data supplied by California Department of Transportation (Hoyt, 1982).

mous. National use of solvent-based adhesives in 1981 was at least 135.2 million lb in 1981. To estimate California use, we multiplied the national use in four major industrial categories (construction, transportation, packaging and other) by the corresponding ratios between California employment and national employment in pertinent industries. In housing construction, for example, this ratio was 0.12. We estimate that a minimum of 16.6 million lb of industrial adhesives were used. The data on solvent content presented in Table 6.3-6 are probably not applicable to industrial adhesives. For lack of better information, we shall assume that the most common emission factor applied in the EDS for source classification code 4-02-007-01 (adhesives application), 1375 lb of organic gas emissions per 2000 lb of adhesives, is valid for the industry. The total solvent contained in the 16.5 million lb of industrial adhesives would therefore be 11.3 million lb (5,700 tons). To estimate how much of individual chemical species are present in industrial solvents, we assumed that the product mix would be in the same proportion as individual solvents are consumed by the adhesives and sealants industry, SIC 2891. Table 6.5-1 shows the proportion of each solvent, as determined by our direct solvent consumption survey. Each chemical's fraction was multiplied by the estimated total solvent use (11.3 million lb) to determine the amount of each chemical used as a solvent in adhesives. Results are also shown in Table 6.5-1.

It should be emphasized that use of solvents in adhesives in California is probably much higher. The U.S. market for adhesives has been estimated to be as high as 3.5 billion lb/year, of which about 2.8 billion lb/yr are solvent-borne (Layman, 1982). Our estimate may therefore be low by a factor of 20.

6.6 SUMMARY OF CALIFORNIA INDIRECT SOLVENT CONSUMPTION

Table 6.6-1 shows our estimates of the use of 22 individual solvents and two solvent classes (aliphatic and aromatic hydrocarbons not otherwise specified) in the formulations we investigated. Paints, coatings and associated thinners account for about two-thirds of the 593.9 million lbs (297,000 tons) of indirect solvent use. The next largest category is automotive products, chiefly because of the major use of ethylene glycol in radiator antifreeze.

This is how the original appears.

Table 6.5-1

SOLVENTS INCORPORATED IN INDUSTRIAL ADHESIVES IN CALIFORNIA

l	Percent of SIC 2891	Use in Adhesives (1000 lb)
	2.14	241.5
cetate	0.30	33.8
lcohol	0.06	7.1
xanone	1.44	162.7
ene glycol mono- l ether	0.02	2.0
ene glycol mono- yl ether	0.04	4.0
l formamide	1.53	172.5
e glycol mono- l ether acetate	0.04	4.6
	0.05	5.7
cetate	0.21	23.9
enzene	-0-	-0-
e glycol	0.18	20.1
e (col mono- l ether acetate	0.04	4.6
ethyl ether	0.01	1.5
ethyl ether acetate	0.06	6.4
	0.01	1.5
	1.47	166.4
	6.52	736.2
l alcohol	0.36	40.3
e	1.22	138.2
thinner	0.15	17.2
l	0.24	27.2
chloroform	9.27	1,047.1
ethyl ketone	12.23	1,382.4
ne chloride	1.66	187.1
isobutyl ketone	0.01	1.1
spirits	32.96	3,724.0
ne	0.01	1.5
oethylene	0.03	3.8
	0.01	1.3
ne glycol	0.05	5.1
	5.56	628.0
oethylene	0.58	65.9
naphtha	6.94	783.7
	0.11	12.8
aneous	14.5	1,643.4
	100.0	11,300.0

Table 6.6-1

SUMMARY OF SAI ESTIMATES OF CALIFORNIA USE OF MAJOR SOLVENTS IN FORMULATIONS IN 1980
(Use in 1000 lb)

Solvent	Paints and Coatings	Thinners	Personal Care	Household Products	Automotive Products	Industrial Adhesives	Total
Acetone	4,400	9,700	800	370	-	242	15,512
Butyl acetate	8,200	1,800	82	12	-	34	10,128
Butyl alcohol	9,200	400	-	-	-	7	9,607
Ethyl acetate	6,500	4,700	85	63	-	24	11,372
Ethyl alcohol	4,900	14,800	3,040	-	-	6	22,746
Ethylene glycol	6,300	-	-	37	165,000	20	171,357
EG monobutyl ether	7,200	2,600	-	700	-	-	10,500
EG monoethyl ether	7,200	2,600	-	1,200	2,400	2	13,402
Hexane	-	-	-	600	-	736	1,336
Isopropyl alcohol	6,300	6,300	2,300	420	-	40	15,360
Methyl alcohol	5,000	4,100	-	-	15,900	27	25,027
Methyl chloroform	-	-	-	160	-	1,047	1,207
Methylene chloride	600	200	-	93	-	187	1,080
Methyl ethyl ketone	16,600	20,400	-	-	-	1,382	38,382
Methyl isobutyl ketone	11,300	800	-	-	-	1	12,101
Perchloroethylene	-	-	-	98	-	4	102
Propyl acetate	4,400	1,200	-	-	-	-	5,600
Propyl alcohol	-	-	-	-	-	1	1
Propylene glycol	4,000	-	312	-	-	5	4,317
Toluene	26,900	22,600	104	381	-	628	50,613
Trichloroethylene	-	-	-	30	-	66	96
Xylene	32,900	13,900	1	1	9	13	46,824
Aliphatic HC	83,400	13,300	-	39	-	4,812	101,551
Other aromatic HC	9,100	5,900	-	-	-	-	15,000
Other	4,800	3,900	-	-	-	2,016	10,716
Totals	259,200	129,200	6,724	4,204	183,309	11,300	593,937

As noted previously, the estimate for use of solvents in industrial adhesives may be an order of magnitude too low.

Apart from ethylene glycol, the most heavily-used solvents in formulations are the unspecificed aliphatic hydrocarbons, including mineral spirits, VM & P naphtha, and kerosene. These account for almost 51,000 tons.

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According to the Motor Vehicle Manufacturers Association (Anon., 1982b), total U.S. vehicle registration in 1980 was 154.3 million vehicles. California registration at the end of that year was 15.0 million vehicles. Assuming that California's antifreeze use is proportional to its fraction of vehicle registration, we estimate statewide antifreeze use to be 17.9 million gallons. Since the major brands of antifreeze contain at least 95 percent ethylene glycol, we assume that the density of the solution is 9.25 lb/gal, so that 165 million lb (83,000 tons) of ethylene glycol was used in California in 1980.

6.4.2 Windshield Washer Antifreeze and Gasoline Drier

Windshield washer antifreeze is sold as a premix or as a concentrate. Typical volumetric percentages for these formulations are 35 and 68 percent, respectively (Gosselin, 1976). Sales data for 1980 were unavailable. According to a survey by Charles H. Kline and Company, Inc. (1975), 1974 U.S. sales of premix and concentrate were 14 and 2 million gallons, respectively. According to the Motor Vehicle Manufacturers Association (Anon., 1982b), U.S. vehicle registration grew by 20.45 percent between 1974 and 1980. Using that growth factor and the California percentage of vehicle registration (mentioned above), we estimate that 1.64 million gallons of premix and 234,000 gallons of concentrate were sold in California in 1980.

Methanol is the principal solvent in these products. The densities of methanol solutions at the stated concentrations are 7.75 lb/gal for premix and 7.19 lb/gal for concentrate. Use of methanol in these products in 1980 is therefore estimated to be 13 million lb (6,500 tons) and 1.7 million lb (850 tons), respectively, for a total of 14.7 million lb (7,350 tons).

Gasoline drier contains about 97 percent methanol. U.S. sales of this product in 1974 were 1.5 million gallons (Charles H. Kline and Company, 1975). Using the same proportionation method as was used for antifreeze, we estimate California sales of 176,000 gal in 1980. The density of a 97-percent methanol solution in water is 6.69 lb/gal. Our estimate of methanol use in this product is therefore 1.2 million lb (600 tons).